Motion Stage for Optical Coherence Tomography

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ABSTRACT

We created a device using a fine adjust cross table capable of fine resolution movement in two directions (X and Y) along with a vertical table capable of motion in the Z-direction along with a spindle mechanism for rotational movement to aid in the fine adjustment of a optical coherence tomography camera.

PROBLEM STATEMENT

Develop a device capable of moving an 80 lbs OCT camera. The device must have adjustable motion in three directions (X,Y, and Z) and be able to rotate. The movement must have fine adjustment capabilities and a user friendly interface such as a joystick or spin wheel.

BACKGROUND

Optical coherence tomography (OCT) is the ideal imaging modality to diagnosing degenerative conditions of the eye, such as macular degeneration. It is non-invasive, requires no special preparation either on the patients' or clinicians' part, and does not harm the patient due to radiation. OCT uses laser light to scan the patient's eye, so precision is an important factor during image acquisition.

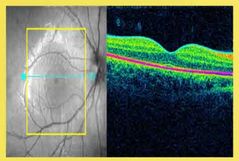

Figure 1: Image from OCT camera. The image on the left shows the scans position on the eye. The image on the right shows the tomography image. The indent in the middle indicates the fovea.

DESIGN CRITERIA

- The device must have fine adjustment in the x, y and z directions
- The device muse be able to rotate
- The device must be capable of being used with humans and sedated animals.
- The OCT camera must be within two inches of the eye
- Control of movement must be simple, such as by a crank or joystick

DESIGN SETUP

Figure 2: Carl Zeiss Meditec, Inc Cirrus OCT camera. The patient rests their chin on the chin rest and the camera operator electronically moves the chin rest to align the eye. Such electronic adjustment is not safe for use with sedated animals.

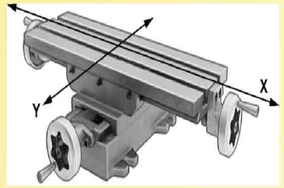

Figure 3: Fine adjust cross slide table. The handles are turned to move the table with precision 0.001m. The platform is 18" by 6", has a load capacity of 150 lbs, has a table travel distance of 12" by 8" and is 5" tall.

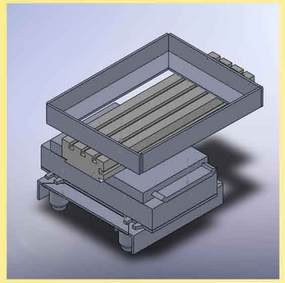

Figure 4: The complete motion stage device is shown here. The stabilizing square on top of the table holds the camera in place and is attached to the cross slide table by several large bolts. The table is then bolted to another stabilizing square. This square is shown as a cutaway in the picture in order to show the ball bearing casters. These casters allow the entire motion stage to rotate. The motion stage will sit on a table capable of motion in the z-axis.

SAFETY & MAINTENANCE

- Sufficient lubrication of device over time
- Cleaning the device after prolonged use
- Must not interfere with sedated animals head
- Ensure slow travel of platform
- Center of mass of the camera must stay within bottom stabilization square to avoid tipping

FUTURE WORK

- Cut angle iron and assemble into base
- Construct base with casters for rotation
- Attach angle iron base and casters to cross slide table
- Test device with 80 lbs weight
- Configure completed device for clinical use
- Convert manual controls to electronic controls

REFERENCES

Clin Experiment Ophthalmol. 2008 Sep 23. [Epub ahead of print] Links
Ophthalmic imaging today: an ophthalmic photographer's viewpoint - a review.

McMaster-Carr. (2008). Cross-Slide Tables & Turntables. Retrieved 30 Nov, 2008, from http://www.mcmaster.com/catalog/114/gfx/large/5179a29c11.gif

The Evolution of Spectral Domain OCT. (2008, July). Retrieved Nov 30, 2008, from Optometric Management:
http://www.optometric.com/archive%5C2008%5CJuly%5CSupplements%5COM_DIBG%5Cimages/OM_July_DIBG_Suppl_A03_Fig07.jpg