Low Resource Bronchoscope

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Project Importance

A Lancet article published in 2010 indicated an rapidly increasing demand for healthcare services in low-income countries.

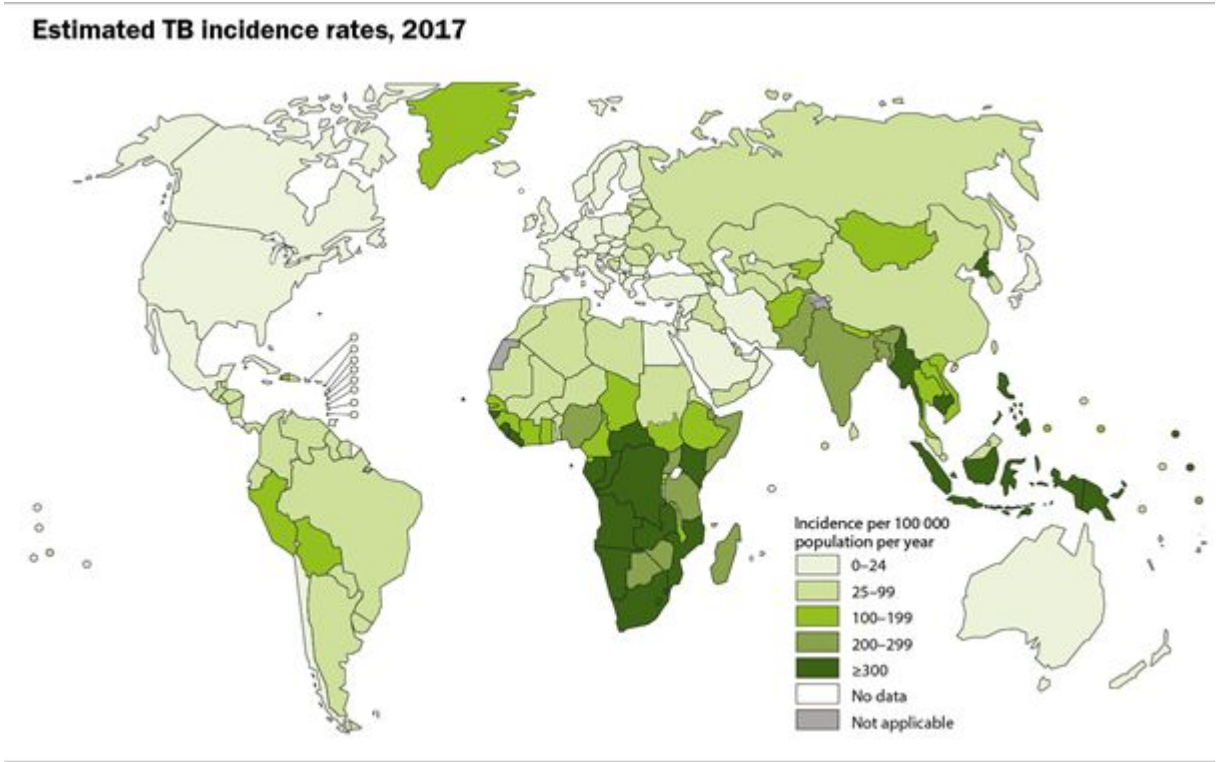
1. Geopolitical reasons: natural and manmade disasters
2. Burden of illness exceeding existing healthcare capacity
3. Lack of healthcare infrastructure
    a. Scarcity of medical facilities, shortage of medication and medical equipment

Respiratory diseases are leading causes of death in low resource areas

The burden of Tuberculosis (TB) is the highest in low-resource areas and was one of the top 10 leading killers in 2018

Estimated 10.6M new cases and 1.5M deaths

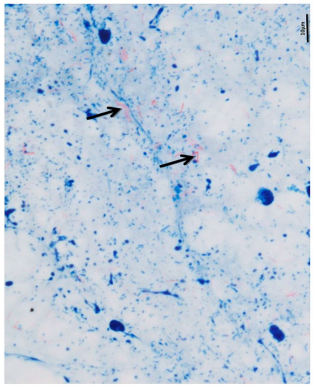
Treatment success rate is 85% in 2018

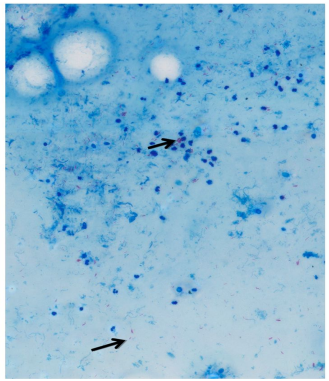


Bronchoscope collects a purer sample and better identifies origin of bacteria

- More than one third pulmonary TB patients cannot produce sputum
- Even when produced, there is an inadequate volume or quality in up to 20% of the case

- Bronchoscope allows sputum to be collected at the suspected TB source
  - Allows doctors to explore airways and collect adequate volume/quality
  - 2015 Review: 83.3% - 92.6% sensitivity and 91.7% - 98% specificity





Problem Statement

We aim to design and develop a fiberoptic bronchoscope that is more cost efficient, portable, and durable than current devices on the market and can also be controlled with common appliances such as iPhone and iPad technology for universal ease of use and increased availability.

Needs Assessment

Functionality
- Match competitors' specifications as closely as possible
- Equipped with a companion application

Cost Reduction
- Materials and hardware shall be selected to reduce cost without large sacrifices to performance
- The device shall be reusable with a single use outer sheath to eliminate reprocessing
- Parts shall be durable and easily replaceable in case of failure

Ease of Use
- More intuitive control scheme than current bronchoscopes
- Integrated with a companion application for real-time video streaming

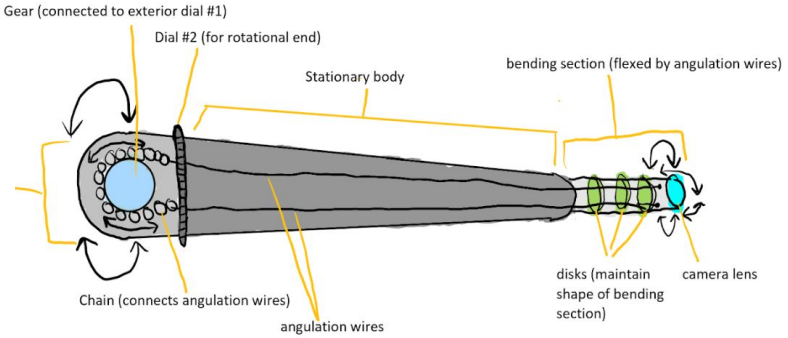
Portable
- Powered using single cell batteries
- Coiled to save space during transport

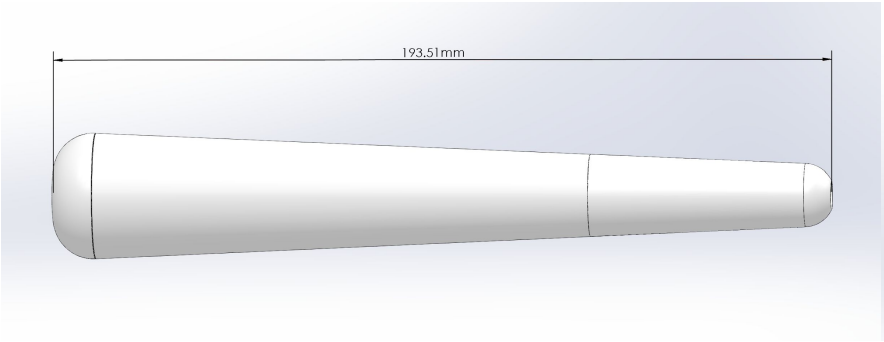
Durable
- Hardware shall be properly insulated
- Parts should be optimized for durability to lower replacement costs

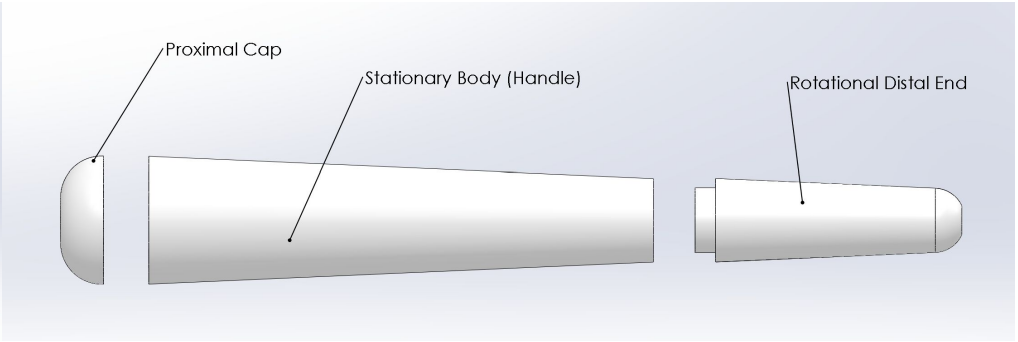
Mechanical Design

Design 1 Progress:

- Started SolidWorks modeling based on industry standards
  - 3D print when completed
- Adjusted design for practicality
  - Rotational end is now distal instead of proximal
  - Added proximal cap for easy access
    - Potentially house electrical components



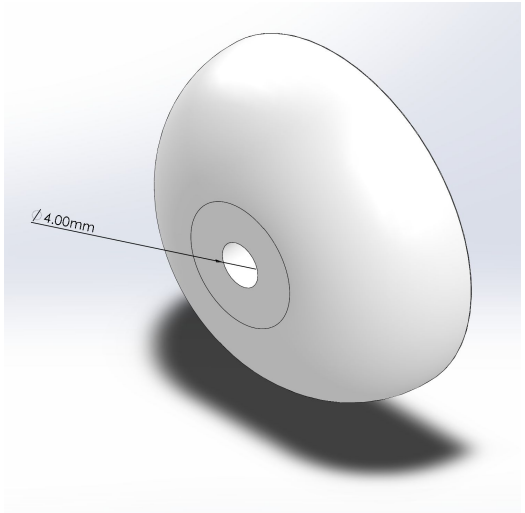


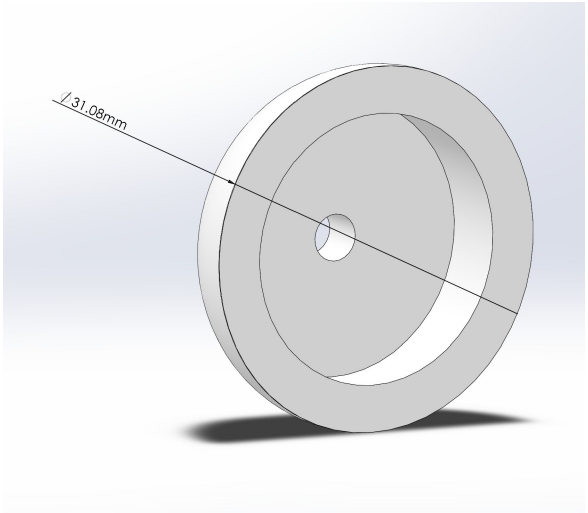


Proximal Cap

What still needs to be done:

- Redefine hole diameter
- Add pegs for secure attachment to handle
- Potentially resize if needed to house electrical components

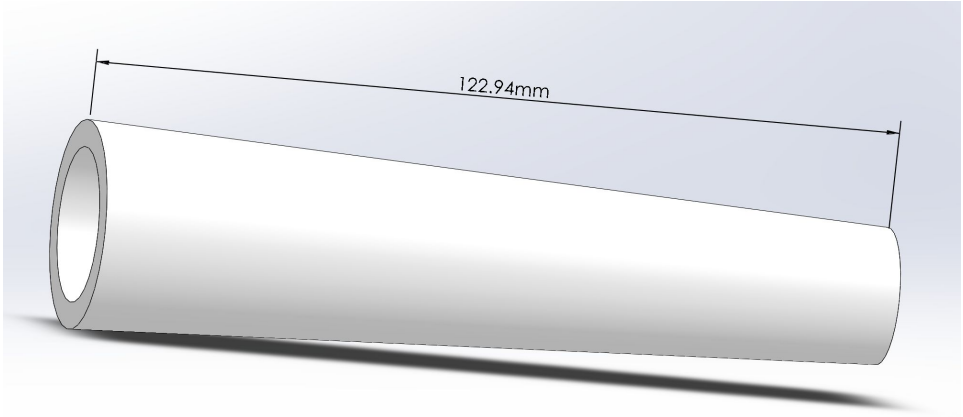


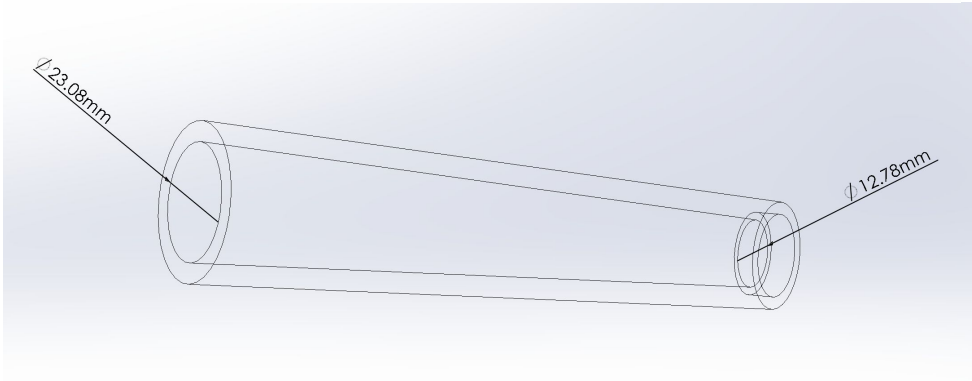


Stationary Body (Handle)

What still needs to be done:

- Add holes for pegs to attach proximal cap
- Add instrumentation channel
- Add grooves for comfortable, secure grip
- Potentially separate into 2 halves for easy printing
    - Would need pegs and holes
- Add grooves to distal end for rotational piece attachment



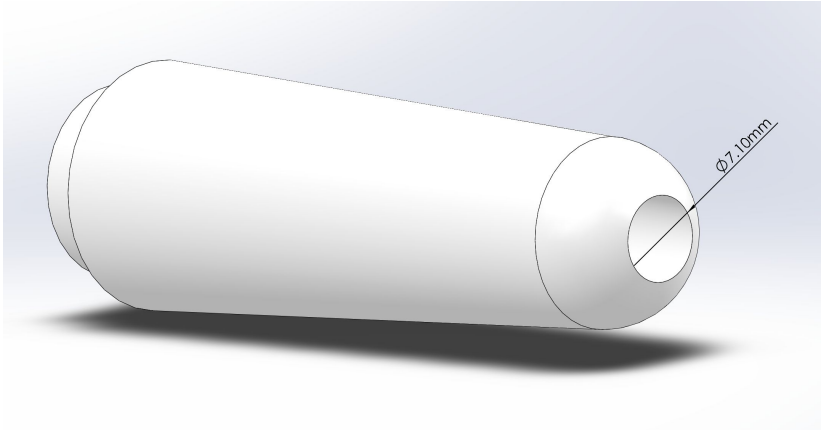


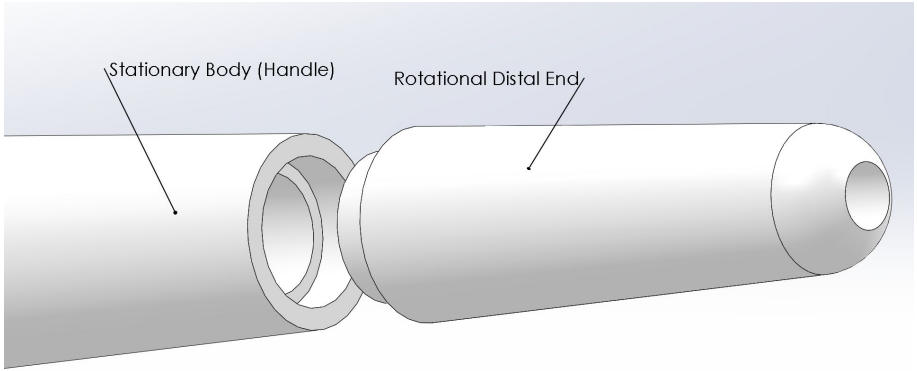
Rotational Distal End

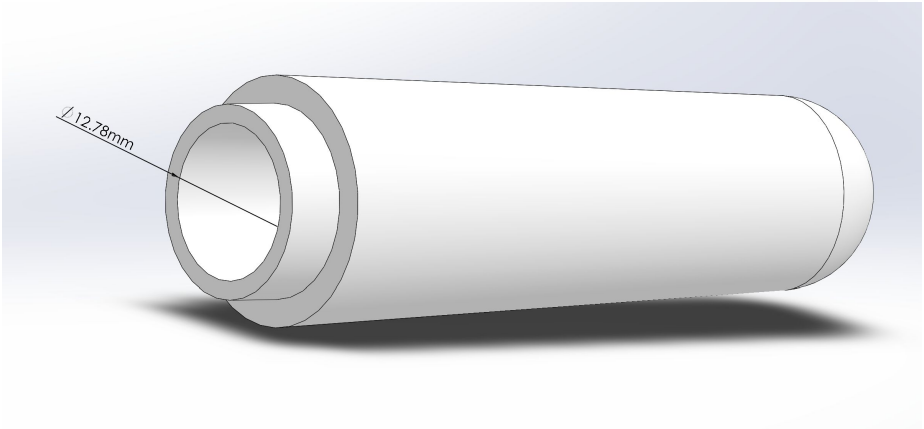
What still needs to be done:

- Add grooves to proximal end for attachment/rotation
- Add slot for gear controls

*Need to develop models for gears and discs

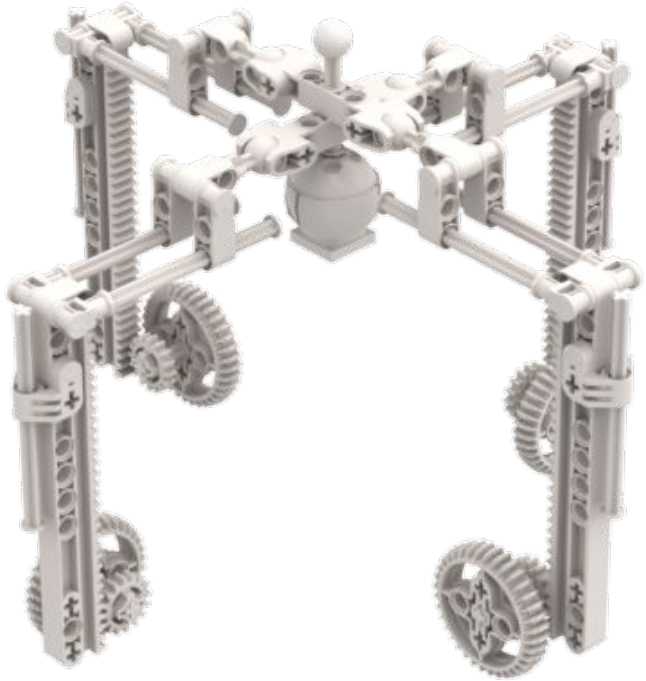






Control System

- LEGO large scale prototype
  - Allows for 2 axis control of bending arm
  - In future would be created using custom parts
    - Modeled using solidworks
    - 3D printed
- Parameters
  - About $25 for parts
  - Measures 6x6 inches
- To do
  - Decide on housing design
  - Model housing
  - Build, test and discuss with sponsor



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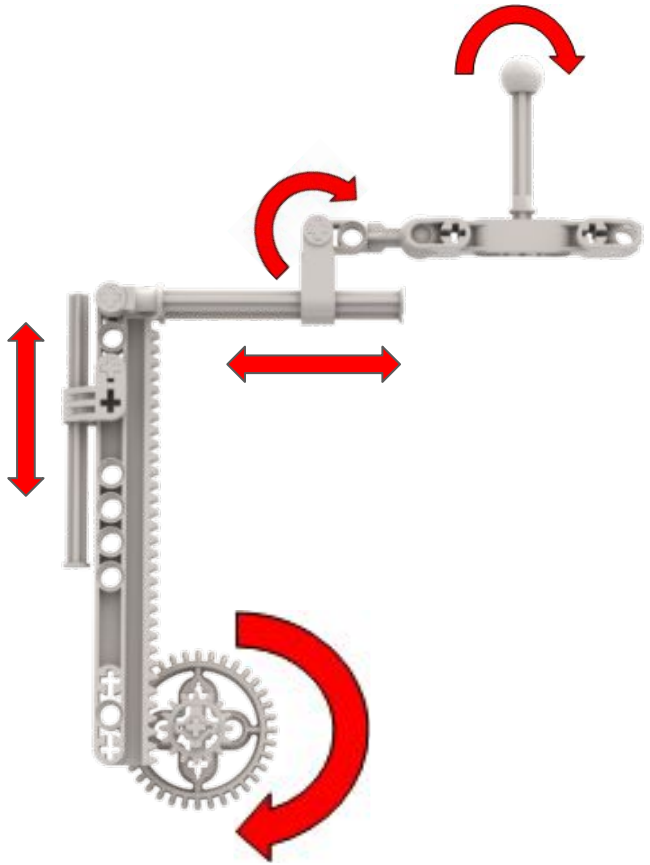
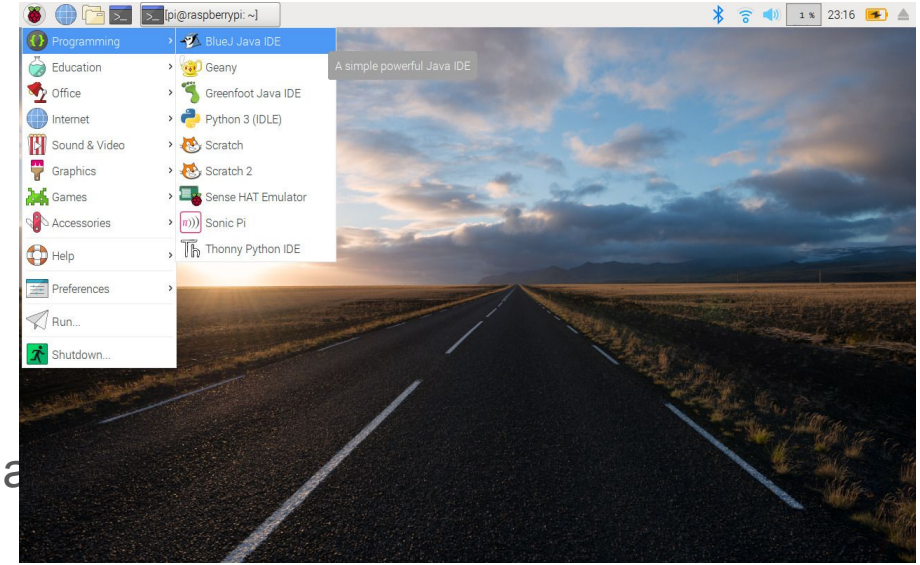


Electrical Design

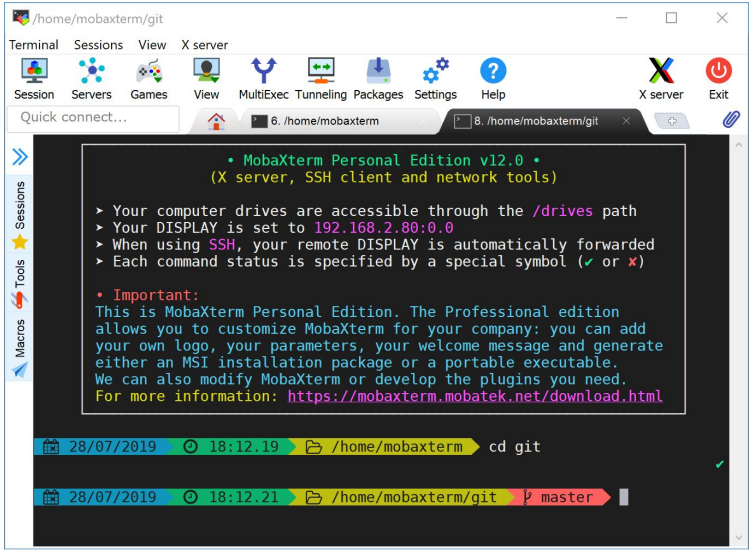
Raspberry Pi 3B Configuration

- Operating System: Raspbian
  - New Out Of Box Software (NOOBS)
  - Contains preinstalled software
  - Internet access via WiFi or Ethernet
- Remote devices are controllable via SSH command line.



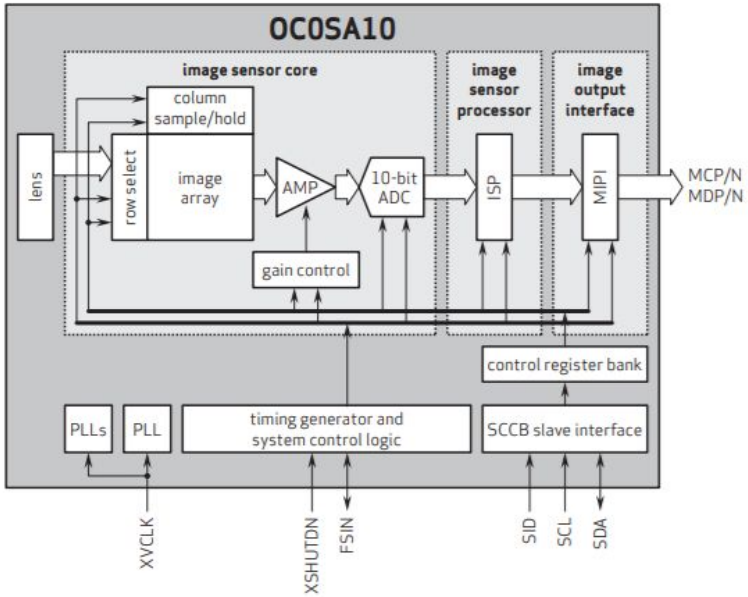
Electrical Design

- Network connections via SSH
  - Secure Shell (SSH) client such as MobaXterm
  - Provides an environment for file transfer
- SSH provides
  - remote command-line
  - external logins
  - remote command execution



Optical Design

- OmniVision OC0SA10
  - Color CMOS camera cube
  - 25% lower power consumption than previous camera chip
  - Built in objective lens
  - Built in strobe illumination
- Specifications
  - 2.58x1.58x2.96 mm
  - 120 degree FOV
  - 800x800 pixel resolution at 60 fps
  - Outputs RAW image data via MIPI interface
    - Compatible with Rasp Pi



Materials

Qty	Product Description	Unit Price	Vendor Name	Supplier
1	OmniVision OC0SA10	187.5	Arrow	https://www.arrow.com/en/products/oc0sa10-eaar-aa0a/omnivision-tech
1	Newport F-SA-C single mode optical fiber	9.75	Newport	https://www.newport.com/p/F-SA-C
1	OOK 50143 16 Gauge wire	9.68	Amazon	Amazon

Misc.

- Makerspace
- Week in Review
- Plan for next two weeks
- Are we on track?

Sources

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