Sensory Abnormality Mapping

Client: Dr. Backonja
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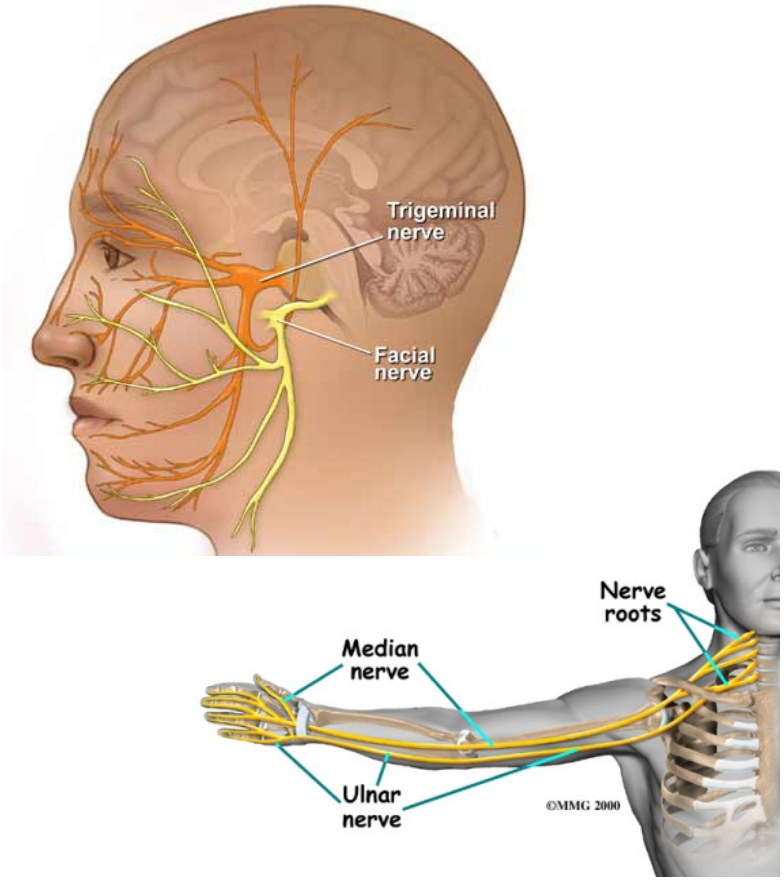
Communicator: Daniel Miller
BWIG: Mason Jellings
BSAC: Jamon Opgenorth

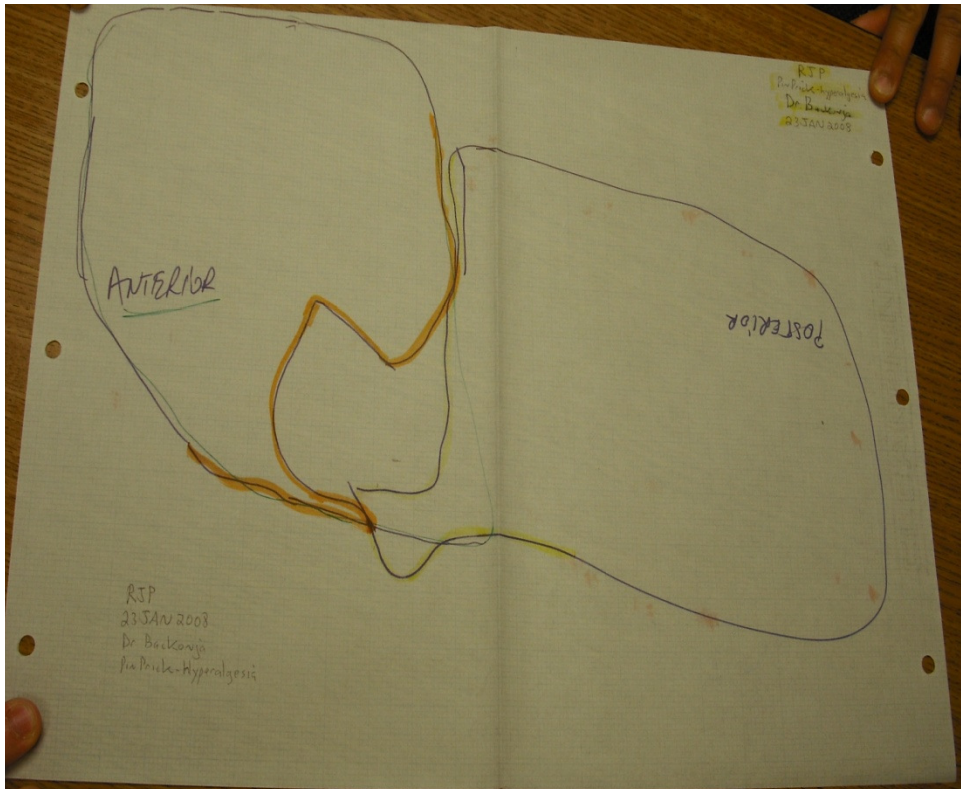
Background

- Client: Dr. Backonja
  - Dept. Neurology (UW-Hospital)
- Researches human sensory abnormalities
  - Loss of sensation
  - Pain
- Typical locations include: face, hands, and trunk



Riversideonline.com, Neoneocon.com

Motivation



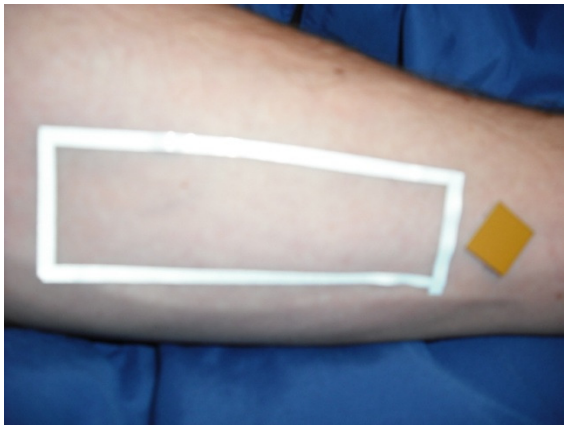
- Studies the response to medicine treatments.
- Requires quantifiable data.
  - Surface area of affected region
- Current system: trace affected area on graph paper.

Design Specifications

- User friendly
- Require less time than current method
- Limited contact with patient
- Accurate
  - Within 10% of actual area
- Precise
  - Within 10% repeatability
- Compatible with all patients and sample types

Preliminary Work

- 2D Area Calculation Program
  - MATLAB
  - Reflective Boarder
  - Calibration Sticker
- OptiTrack Cameras
  - For use with Design 2
  - Java and C++
    - No included software
    - Uses COM



OptiTrack.com

Design 1: Previous Design

- Uses 3 OptiTrack FLEX:V100 Cameras
  - IR Cameras
- Uses OptiTrack PointCloud Software
  - Used to track the 3D coordinates of objects viewed by the 3 cameras
- Uses IR LED as Tracked Object
  - Used to “Trace” 3D area on skin
- Uses MATLAB to Connect the Coordinates and Calculate Area
  - Triangles and ½ cross product algorithm

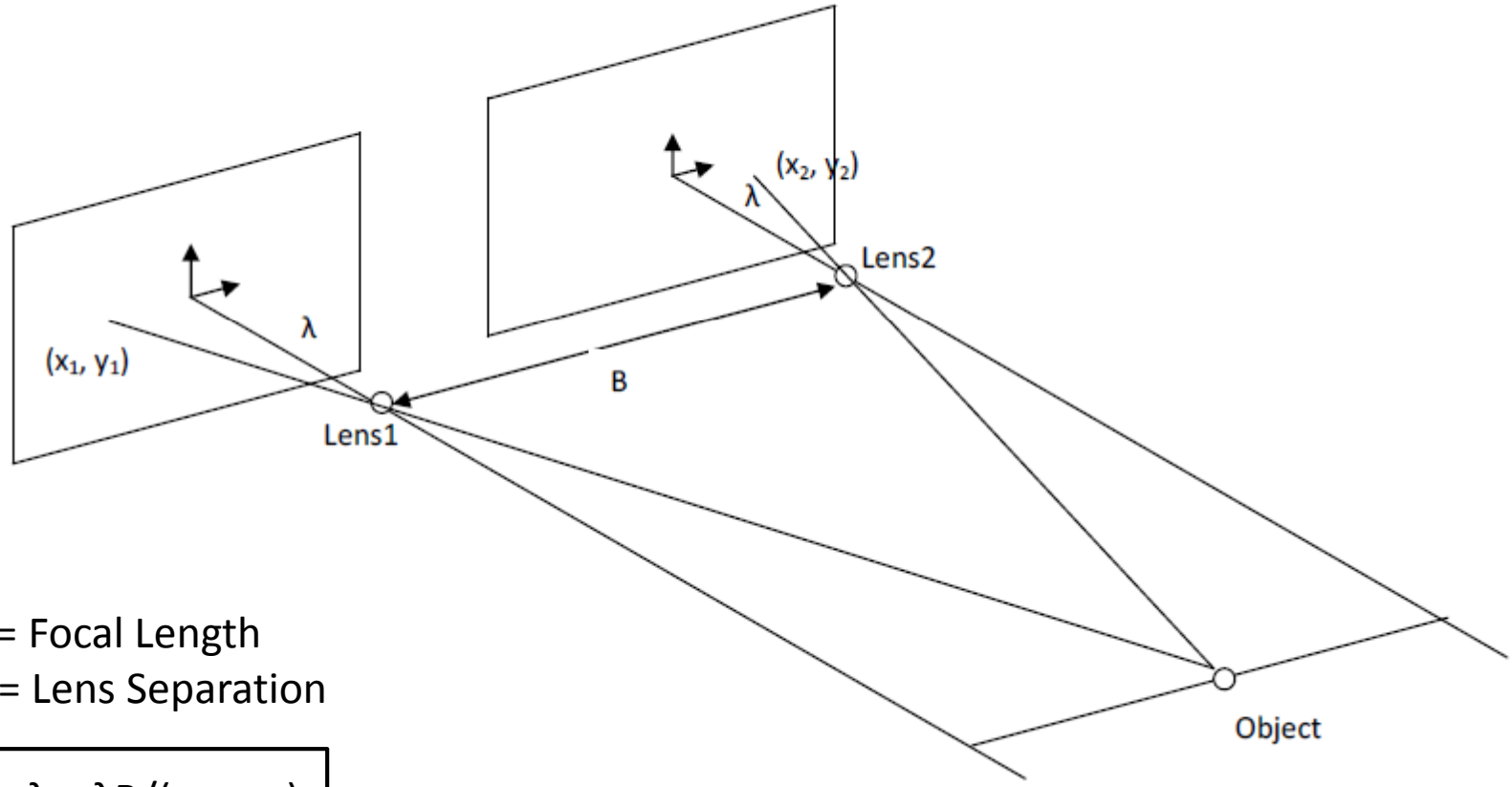
Design 1: Previous Design

- Limitations
  - All three cameras must “see” the LED at all times
    - Awkward
    - No opposite side support
  - Calibration repetition
  - Lack of precision
    - Patient movement
    - Clinician inconsistency
  - Algorithm issues
  - PointCloud + MATLAB
    - Consolitation and GUI required

Design 2: Stereo Imaging

- Uses 2 OptiTrack FLEX:V100 Cameras
  - Greyscale imaging functionality
- Uses 2 Still Images Taken by Cameras Separated by a Known Distance
  - Calculates depth at any point
    - Principle behind binocular vision
- Uses Triangulation and Area Calculation Algorithm
- Uses Java and C++ for Camera Communication and GUI

Design 2: Stereo Imaging

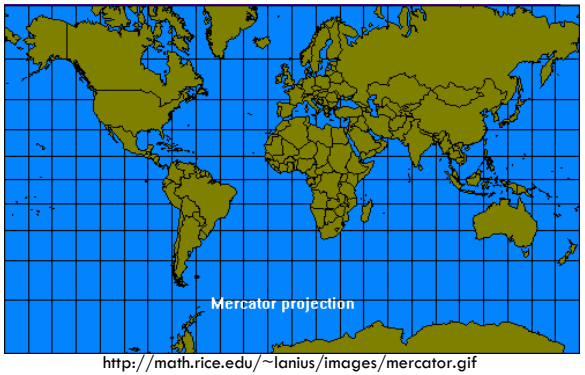


λ = Focal Length
B = Lens Separation

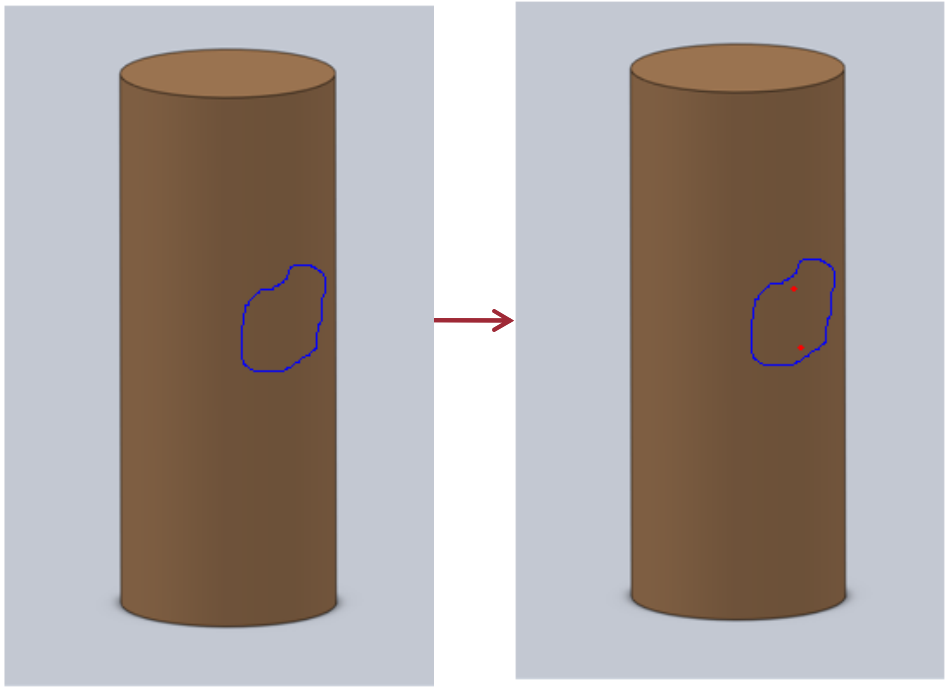
$$Z = \lambda - \lambda B/(x_2 - x_1)$$

Design 3: 2D Projection Method

- Similar to Mercator projection
- Requires multiple pictures



http://math.rice.edu/~lanius/images/mercator.gif



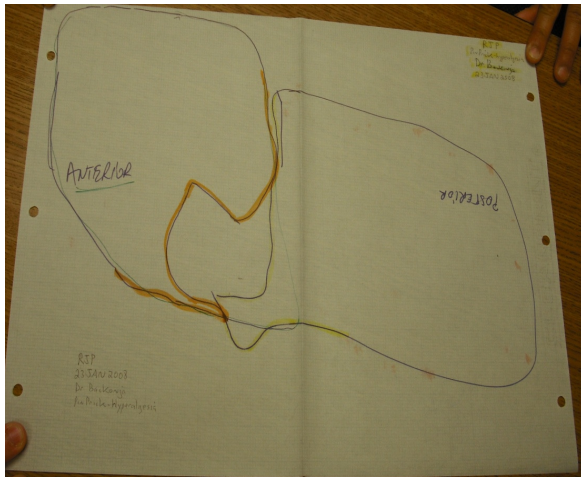
- Splices pictures and reforms a master image
- Calculates area of 2D image

Design Matrix

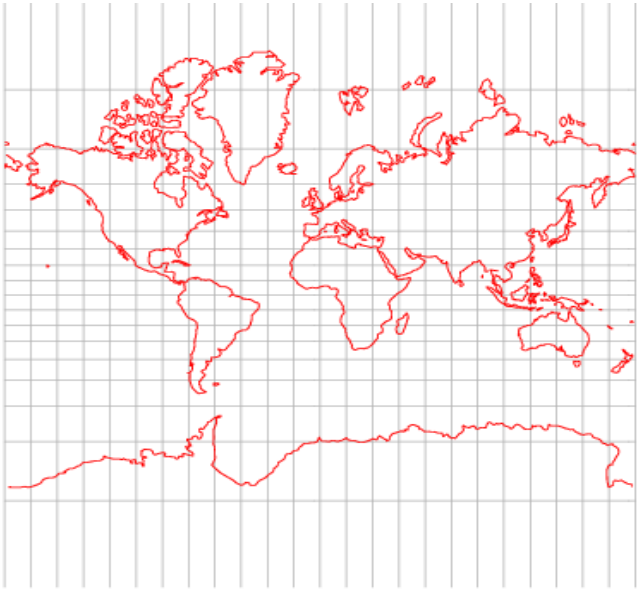
Design	Feasibility (15)	Accuracy (20)	Ease of Use (30)	Ergonomics (25)	Cost (10)	Total (100)
Old Design	13	10	10	20	3	56
3D Coordinates	5	15	15	20	5	60
2D Projection	5	15	25	15	10	70

Final Design

- 2-D Design
  - Measures Enclosed Area of Graph Paper Sampling
  - Intermediate Deliverable
  - Builds Familiarity/Trust of Program



- 3-D Design
  - Produces “Mercator projection” of Sampling Area
  - Cost Efficient
  - Simple 3-Step Process



Future Work

- Finalize/test 2-D program in Java
- Deliver 2-D program to client
- Program 3-D “Mercator” program
- Test program
- Deliver final program to client

Acknowledgements

- Client: Dr. Backonja
- Advisor: Professor Amit Numinkar

References

- http://math.rice.edu/~lanius/images/mercator.gif
- OptiTrack.com
- Riversideonline.com,
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QUESTIONS?