

3D Scanning Application for Cranioplasty Procedure

Alex Mathews, Joshua You
Spring 2015

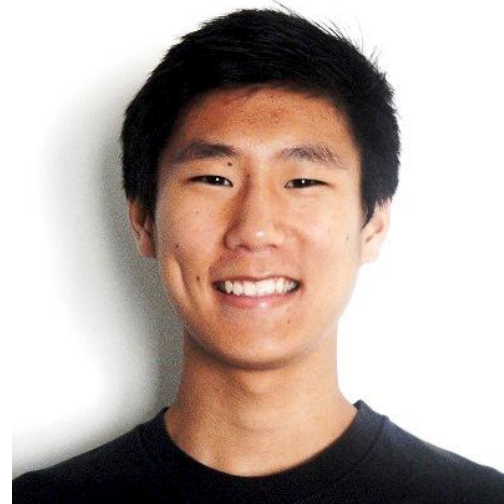
Topics

- Developing 3D Scanning methods and applications for Cranioplasty Procedures
- Segmentation of a 3D image

Team Members



Alex Mathews



Joshua You

Mentors

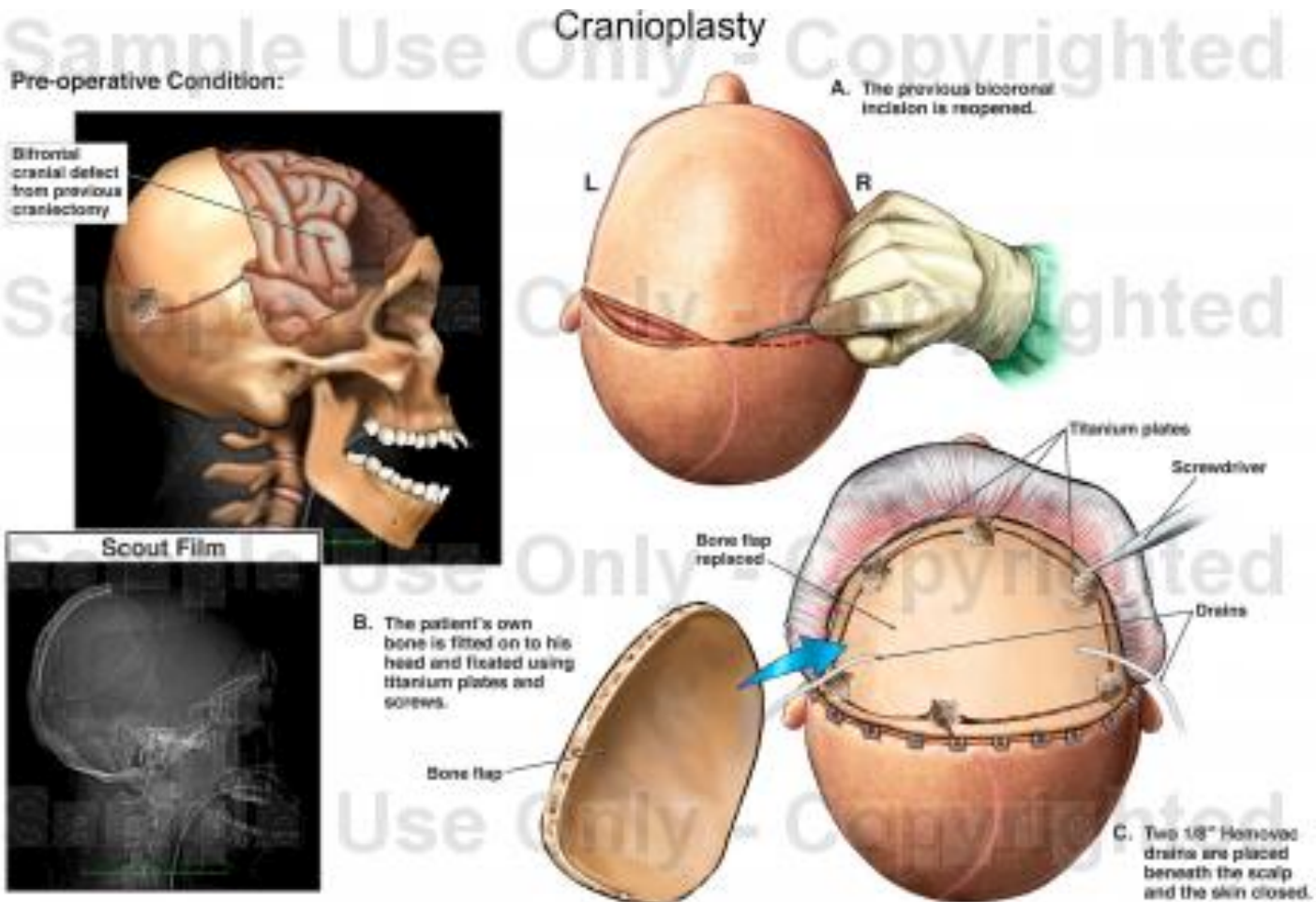
Dr. Mehran Armand, JHU APL

Ryan Murphy, BIGGS Lab

Dr. Chad Gordon, JHMI

Captain Grant, Walter Reed Hospital

Cranioplasty Procedures



Cranioplasty Procedures



Polaris System



Polaris System

- complicated
- requires large fiducial
- constant attention from surgical technician
- very expensive

CIS II Project

- Develop an inexpensive system to replace Polaris
 - 3D depth-sensing and imaging “Structure Sensor”

Goals

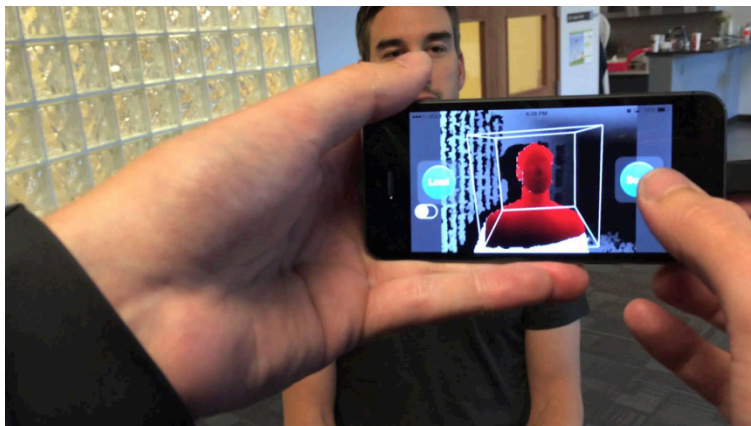
- Reduce the costs and complexity cranioplasty implant creation
- Attempt to use 3D scanning solutions to replace use of the Polaris system for defect identification

Relevance

- Surgical time is very expensive
- Polaris system
 - complicated
 - requires large fiducial
 - constant attention from surgical technician
 - very expensive
- 3D scanning has recently become more popular due to the dropping costs of 3D Printing

Structure Sensor

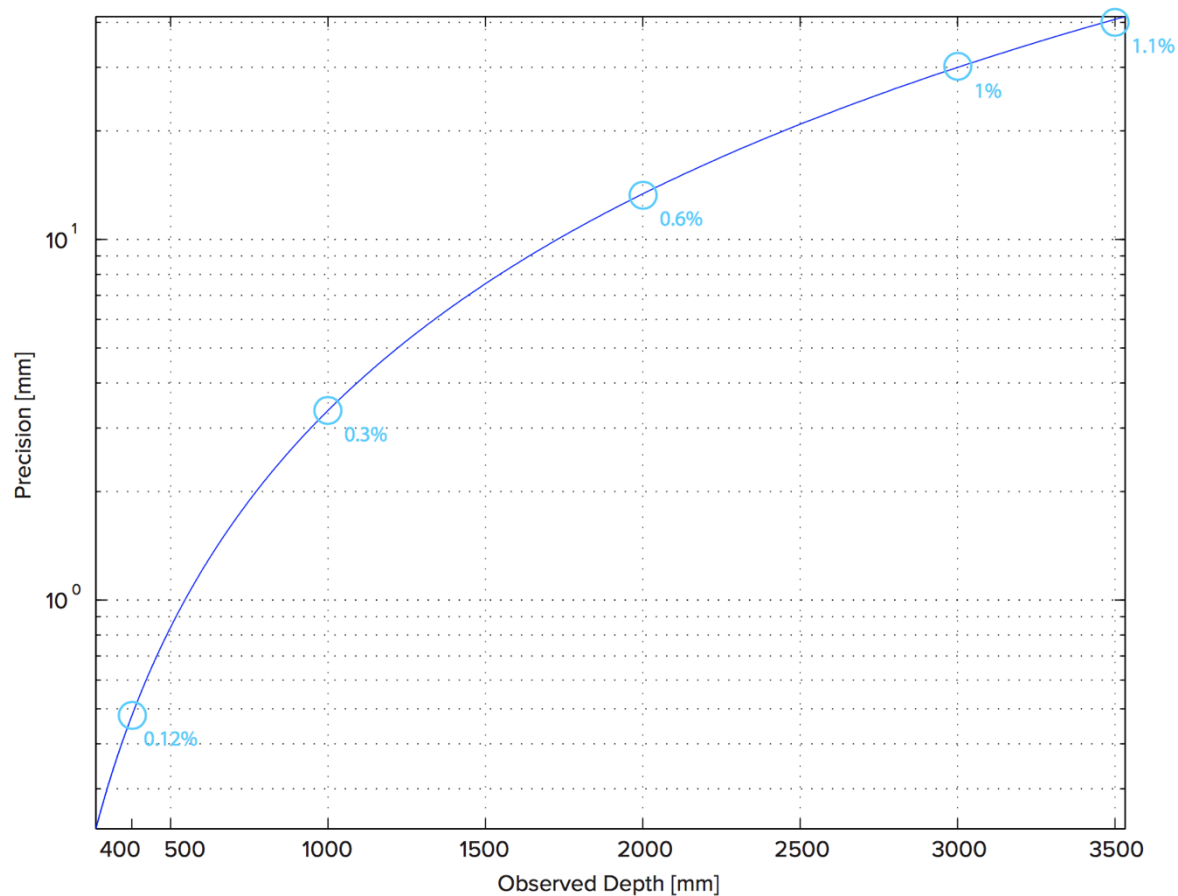
- \$350 iPad accessory
- USB interface
- Open Source code
- Comes with SDK
- Supported by Occipital



OpenNI 2^{C++}

Structure Sensor Accuracy

Structure Sensor Depth Precision



Segmentation Approach

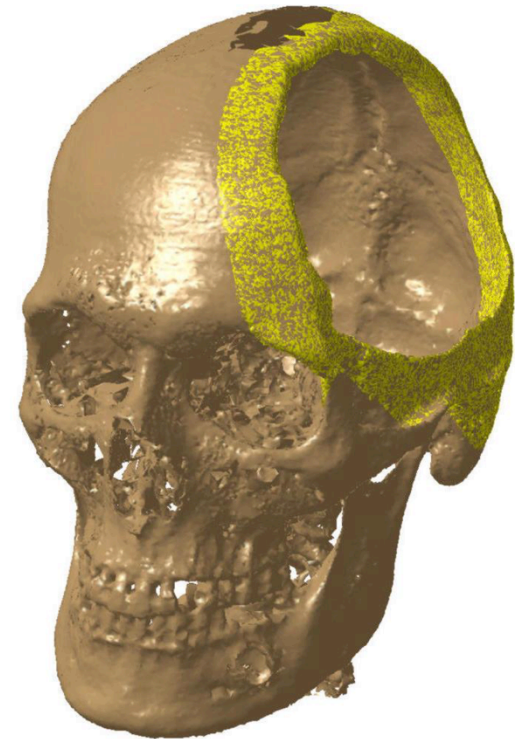
- Color
 - General location of the defect
 - Relies on high contrast between ink and skull
- Depth
 - Used to obtain an accurate 3D point cloud
 - Will be sensitive to large changes in surface angle

Development: Planar Surface

- Start with a flat panel that has a surface defect
- Simple, made of white plastic
- Defect should have depth similar to skull thickness

Development: Phantom Skull

- Attempt defect identification with model skull
- Use realistic ink and surface colors with lower contrast



Development: Mock OR

- Test in actual scenario
- Compare with current Polaris system



Deliverables

Minimum

Paper regarding color and depth based segmentation for defect detection

Analysis would use processed.stl file renders from sensor programs

Expected

Integration into the cranioplasty surgical procedure

Ability to use the scanner in an uplink mode

Maximum

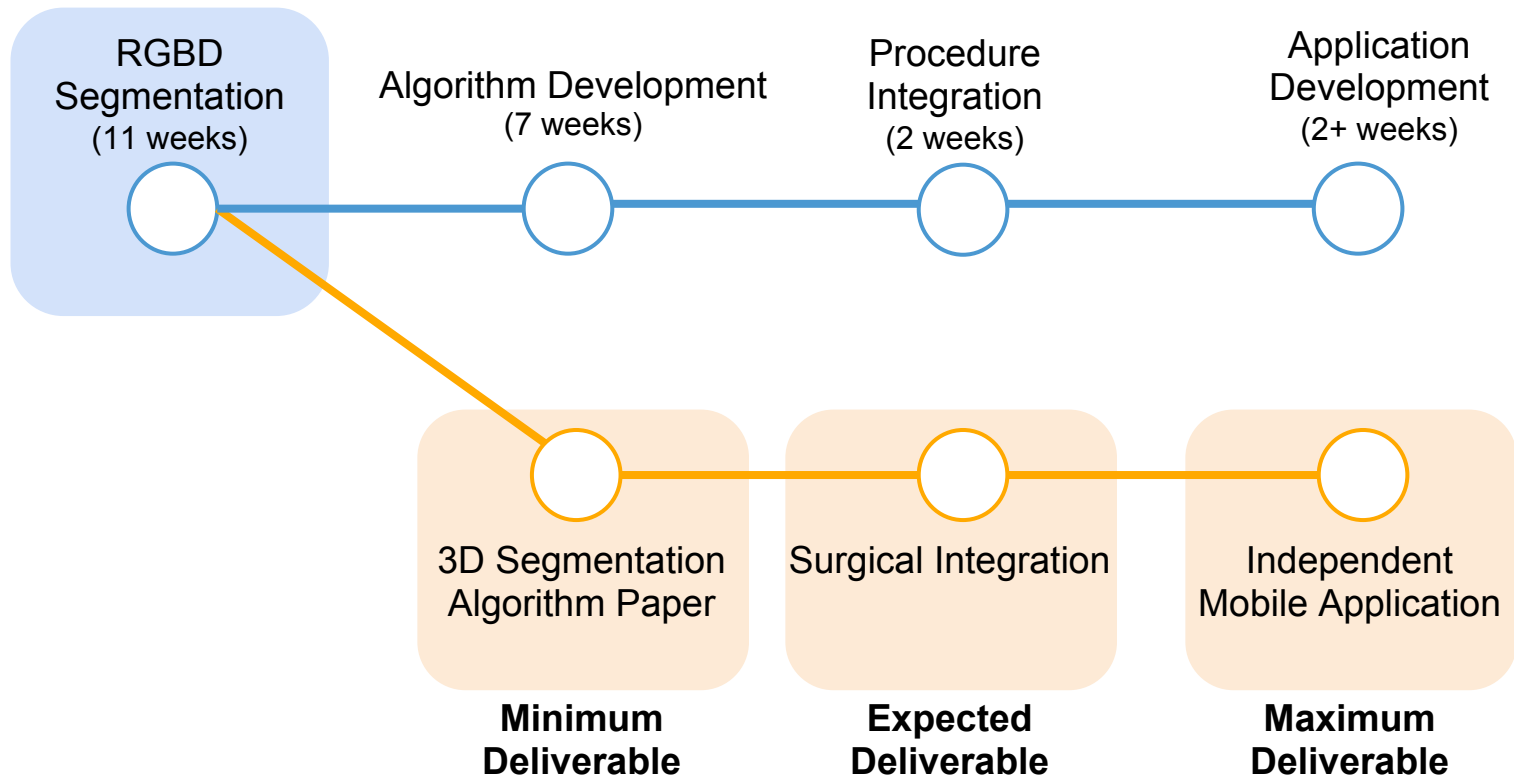
Tablet application with integrated 3D scanning

Dependencies

- Structure Sensor
 - purchased by Dr. Armand
- Mock Operations
 - once a month with Dr. Gordon
- Test Objects
 - printed at the DMC or Walter Reed

Timeline

CIS II Project



Management Plan

Josh - Scanner integration, application development

Alex - Segmentation algorithm