Intraoperative Fiducial Tracking in TORS

CIS II Project #15

Check Point Presentation

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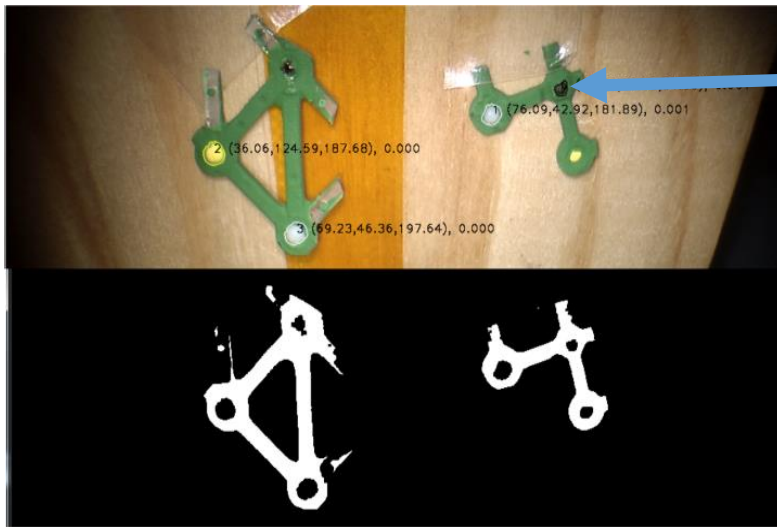
04/03/14

Project Overview

• Project Goal:

The goal of this project is to design and implement an intraoperative fiducial tracking algorithm in TORS that can accurately track the fiducial under the endoscope.
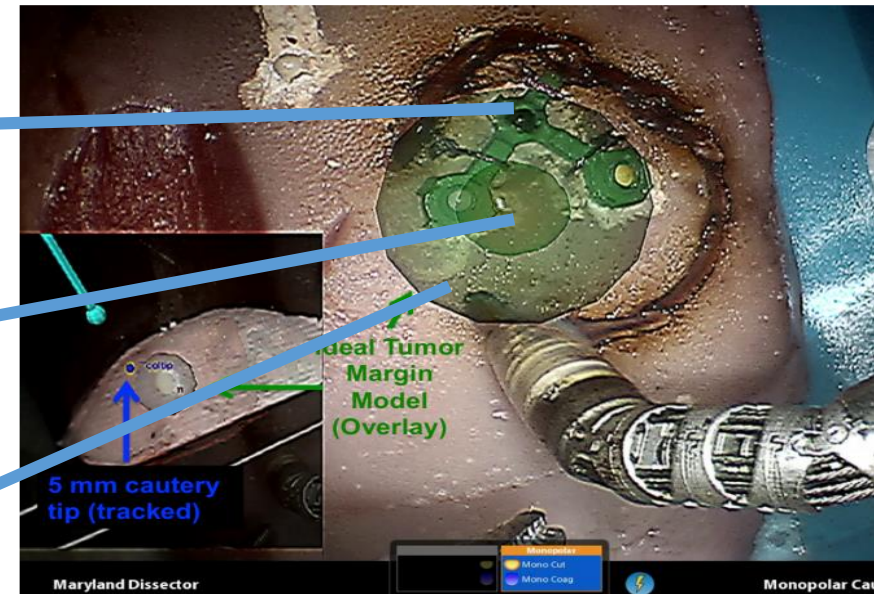

Fiducial

Ideal virtual tumor estimated according to the position of the fiducial

Ideal virtual tumor margin

Images courtesy of Wen P. liu

Project Overview (Continue)

- ## Project Background :

- TORS: TransOral Robotic Surgery

- The base of tongue tumors has become a significant health care concern. Because most base of tongue tumors are buried deep in the musculature of the tongue, when doing the transoral surgery, expert surgeons always rely on experience to remain correctly oriented with respect to critical anatomy.

- Such practice leaves considerable room for improvement and has brought TORS. It is a minimally invasive surgical intervention for resection of base of tongue tumors.

http://www.ohsu.edu/xd/health/services/comprehensive-robotics-program/surgical-services/transoral-robotic-surgery-tors.cfm

Project Overview (Continue)

- ## Technical Summary:

- Implementation:

    Coding with C++ (using cisst and saw libraries and OpenCV)

- Testing:

    Work on the da Vinci robot console

    Design of new fiducial

Project Dependencies

- Cisst and saw understanding

  Solution: Read tutorials and ask Wen and Anton

  Current Status: Still working on it. Need to keep on learning throughout the project. Have understood

  what is needed so far.

- ~~Access to 3D printer and knowledge of CAD~~   Would use the little handcraft thing to design new fiducials

  ~~Solution: Read books and ask Wen~~   Current Status: Got the handcraft material

- Access to the robot

  Solution: Ask Wen and Prof. Taylor for permission

  Current Status: Got it

Project Deliverables

- Minimum (Planned 4/10):

  Implementation of fiducial segmentation of the ~~intraoperative~~ recorded endoscopic images

  Implementation of fiducial tracking of the ~~intraoperative~~ recorded stereo video

  ~~Test and optimize the implementation to confirm better result than the already existed tracking method~~

- Expected (Planned 4/22):

  Real-time fiducial tracking under the robot endoscopic camera

  Optimization of the implementation to confirm better result than the already existed tracking method

- Maximum (Planned 4/29):

  A more accurate tracking under intraoperative scenario

  Video recording for the intraoperative fiducial tracking process

  A new fiducial for better and more accurate tracking

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Project Deliverables (Continue)

- ## Current State:

  Still working on the minimum deliverable

- ## Possible changes to the deliverable completion dates:

  Minimum (Planned 4/10) ⟶ Might be delayed to 4/15

  Implementation of fiducial segmentation of the recorded endoscopic images ⟶ Should be done by 4/10
  Implementation of fiducial tracking of the recorded stereo video ⟶ Should be done by 4/15

  Expected (Planned 4/22) ⟶ Should not be changed

  Real-time fiducial tracking under the robot endoscopic camera
  Optimization of the implementation to confirm better result than the already existed tracking method

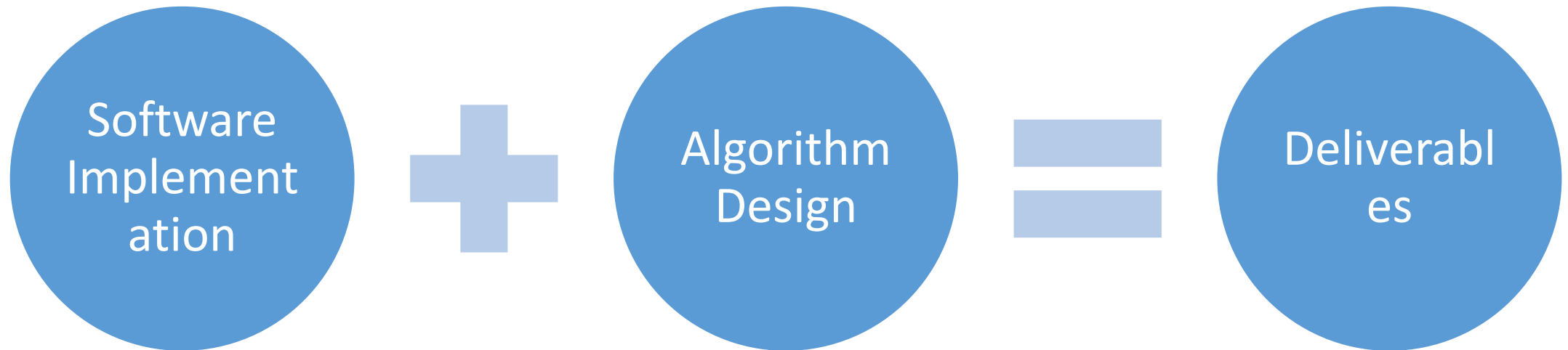 Maximum (Planned 4/29) ⟶ Might be delayed to around 5/3

  A more accurate tracking under intraoperative scenario ⟶ Should be done by 4/29
  Video recording for the intraoperative fiducial tracking process
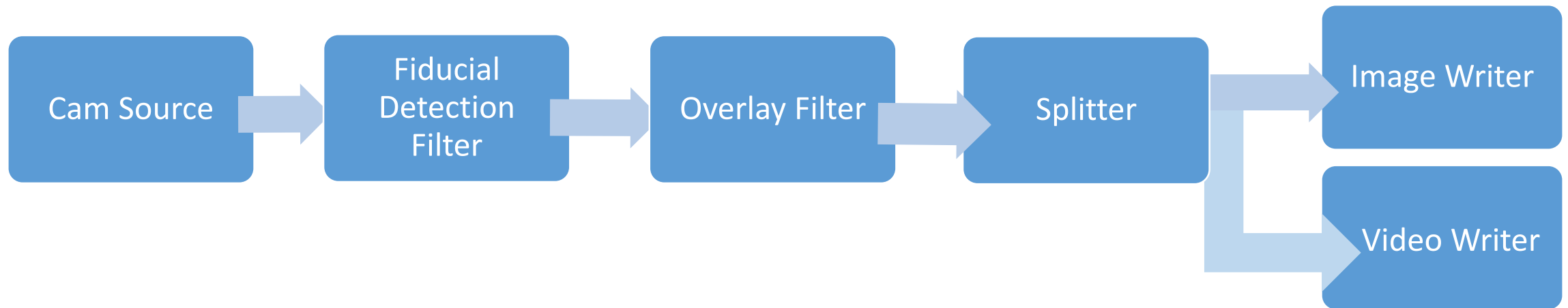 A new fiducial for better and more accurate tracking

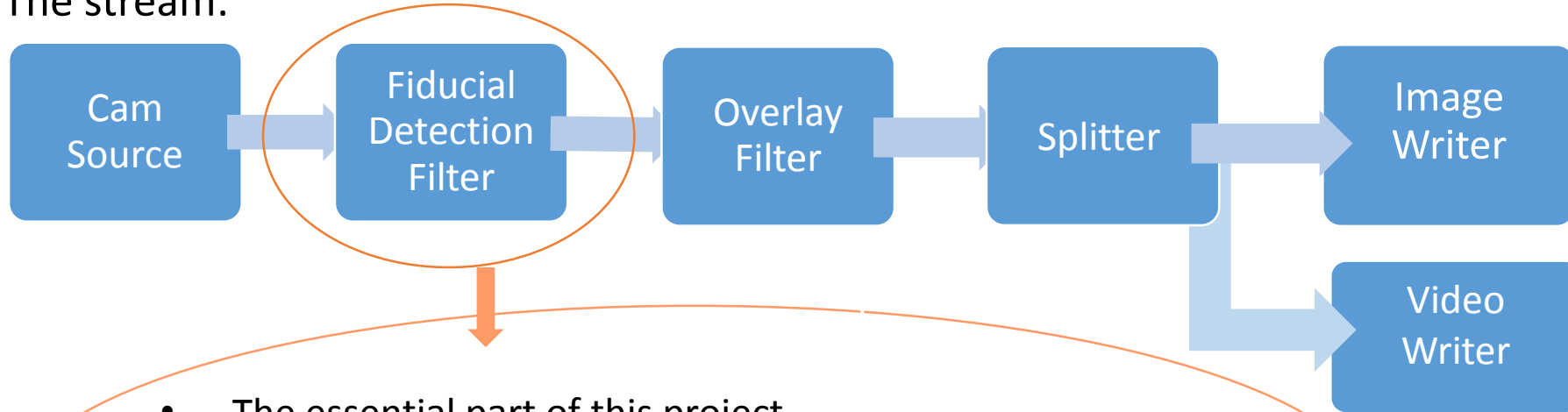# Project Deliverables (Continue)

- Work Summary:

- ## Software

  - Now Using: Cisst   C++   OpenCV

  - Need to build a stream for implementation:

Project Deliverables (Continue)

- Software

- The stream:

Cam Source → **Fiducial Detection Filter** → Overlay Filter → Splitter → Image Writer / Video Writer

- The essential part of this project
- A child class of svlOverlay
- For the mono image from each channel, it detects the fiducials on the image, and store the information of the sphere fiducials as its member variable

Project Deliverables (Continue)

- ## Software Progress:

  - Have roughly built the stream

  - Now working on the fiducial detection function in the fiducialdetection filter

  - Problems:
    Have some questions about the reference and copy of the images
    Have some problems using OpenCV functions
    Solving:
    Schedule meetings with the mentors

Project Deliverables (Continue)

- ## Algorithm

  - Have been using Matlab for algorithm design, since it's more straightforward and has many similar functions as OpenCV

  - Use both the color information and the edge detector to detect the frame

  - Use the adjacency and color information to detect the fiducials from the frame

  - For fiducial detection within the video and realtime camera, apply Kalman filter

Project Deliverables (Continue)

- ## Algorithm Progress

- The detection of the fiducial frame contour

- Still optimizing the fiducial detection part

Project Key Dates

Feb. 20: Complete Software Installation: Visual Studio 9.0, CMake, SVN, cisst saw library, OpenCV   done

Feb. 21: Begin algorithm design   done

Feb. 22: Begin software and cisst study   begun

Feb. 23: Begin new fiducial design (optional, might do it after testing the implementation on the robot)   begun

March. 1: Print the new fiducial (optional)   not yet

March. 7: Algorithm study and design complete   roughly done (might modify a little)

March. 10: Begin algorithm implementation (coding) with C++   begun

April. 10: (Minimum deliverable) Complete algorithm implementation and optimization   might delay

April. 12: Begin testing on the robot   might delay to 4/15

April. 22:   (Expected deliverable) Complete testing on the robot and get the intraoperative tracking result   might delay

April. 29:   (Maximum deliverable) Complete optimization and record video for the fiducial tracking during TORS   might delay

May. 9:   Post session and project report

Project Management

- Bi-weekly tele-conference with Wen before March.

  Weekly meeting with Wen afterwards through the completion of the project.
  Every Monday afternoon. With occasional exceptions.
  Keep contacting by emails.

- ~~Bi-weekly~~ Scheduled meeting with Anton after the beginning of implementation.

Thank You