Medical Core · Research Prototype

SMCNavi · HoloLens Surgical Navigation

Integrated tracking, registration, and calibration in SMCNavi, then carried the result into a HoloLens spatial interface.

Period 2023.07 - present | Evidence state Prototype · Ongoing | Portfolio tier Medical Core

A custom 3D Slicer surgical-navigation platform developed by DIGITRACK with Samsung Medical Center in a research collaboration, plus a separate HoloLens spatial-interface extension.

Figure 1. Full-length research-prototype demonstration connecting the HoloLens 2 digital twin with tracked instruments and image presentation. It uses de-identified research imagery and is not evidence of clinical outcome.

Problem and system boundary

Oral and maxillofacial navigation must align medical images, patient and instrument coordinates, procedure-specific tools, and spatial presentation in one flow; fragmented functions make registration state and data flow difficult to inspect.

Owned decisions and implementation

My role

3D Medical Imaging · Surgical Navigation Developer

Designed the overall software architecture and served as the primary implementer for DICOM and 3D-model loading, MPR and 3D visualisation, the optical-tracker SDK and data pipeline, image/patient/marker/instrument transforms, patient registration and feedback, marker/non-standard/long-instrument calibration, six workflows and mirroring, HoloLens-PC communication and interaction, and phantom integration tests and verification tooling.

SMCNavi platform overview

SMCNavi integrates DICOM and 3D-model loading, MPR and 3D visualisation, optical tracking, patient registration, instrument calibration, and procedure-specific UI in one custom 3D Slicer desktop platform. The HoloLens work is a separate PC-side extension connected to SMCNavi.

Six oral and maxillofacial workflows

The following are implemented and demonstrated software workflows; they are not evidence of clinical efficacy.

- Maxillary tumour-removal navigation
- Mandibular tumour-removal navigation
- Bimaxillary-surgery navigation
- Mandibular-motion tracking
- Bone-graft placement
- Zygomatic-orbital fracture mirroring

Tracking, registration, and calibration

Built explicit transform paths between the patient, instruments, and image models so the inputs and feedback at each stage could be inspected.

- Optical-tracker SDK integration and the live tool/marker data pipeline
- Transform chain across image, patient, marker, and instrument frames
- Patient registration and registration-state feedback
- Patient and instrument marker calibration
- Non-standard and long-instrument calibration

HoloLens spatial interface

Rendered SMCNavi-owned registration and workflow state in a separate PC extension and connected it to HoloLens 2 spatial presentation and interaction.

- Transform and approved image/model exchange through OpenIGTLink
- PC rendering and spatial placement with Unity and MRTK
- HoloLens 2 presentation through Holographic Remoting
- Return of HoloLens interaction input to the PC extension

- Phantom integration tests across optical tracking, SMCNavi, and HoloLens

From tracking observations to HoloLens interaction

Explanatory system-relationship diagram; it is not photographic, experimental, or clinical-outcome evidence.

01 **Optical tracker** — Tool and marker observations

Tool and marker observations

02 **SMCNavi** — 3D Slicer · images and models · transforms, registration, calibration · six workflows

Transforms, images, models

03 **OpenIGTLink** — Transforms and approved image/model data

Connected data

04 **HoloLens PC extension** — Unity · MRTK · rendering

Rendering and input

05 **Holographic Remoting** — PC render stream · input return

Holograms and interaction

06 **HoloLens 2** — Spatial presentation · interaction

SMCNavi-HoloLens path · Research prototype

Explanatory system relationship diagram; it is not photographic or experimental evidence.

Verification and evidence ledger

Two full-length videos and approved interface, coordinate-frame, instrument, and phantom derivatives show a working research prototype carrying position, model, image, and interaction data from SMCNavi through the HoloLens path.

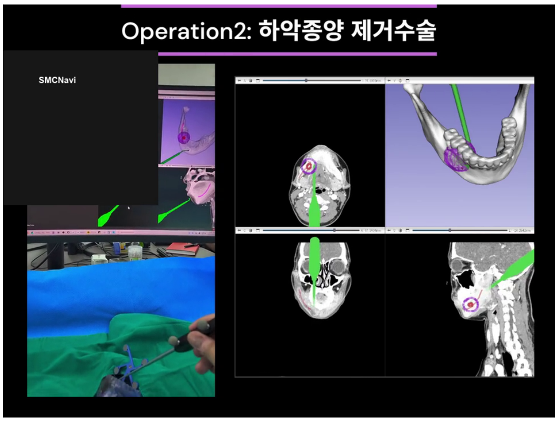

Figure 2. Full feature video moving through six oral and maxillofacial workflows in SMCNavi. It uses de-identified research imagery and is not evidence of clinical outcome.

Figure 3. Integrated SMCNavi UI and HoloLens-PC connection view. This derivative uses de-identified research imagery and is not evidence of clinical outcome.

Figure 4. Six oral and maxillofacial software workflows. This derivative uses de-identified research imagery and does not establish clinical efficacy.

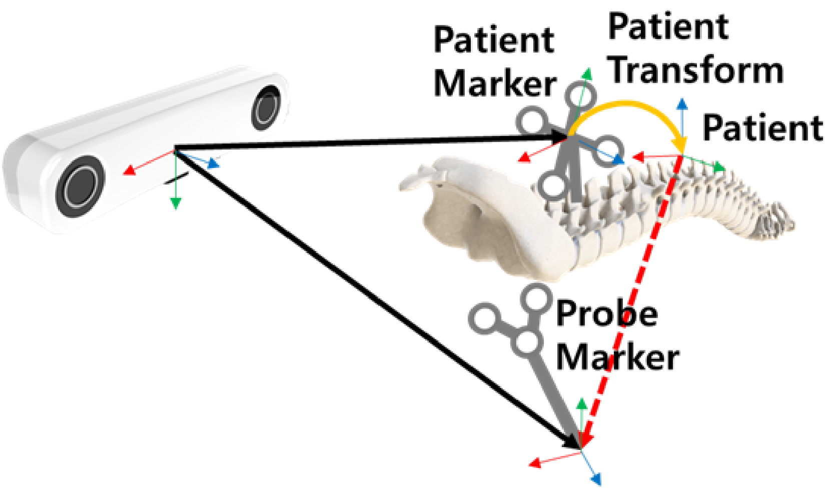

Figure 5. Coordinate frames: patient-marker and probe-marker transforms relative to the optical tracker.

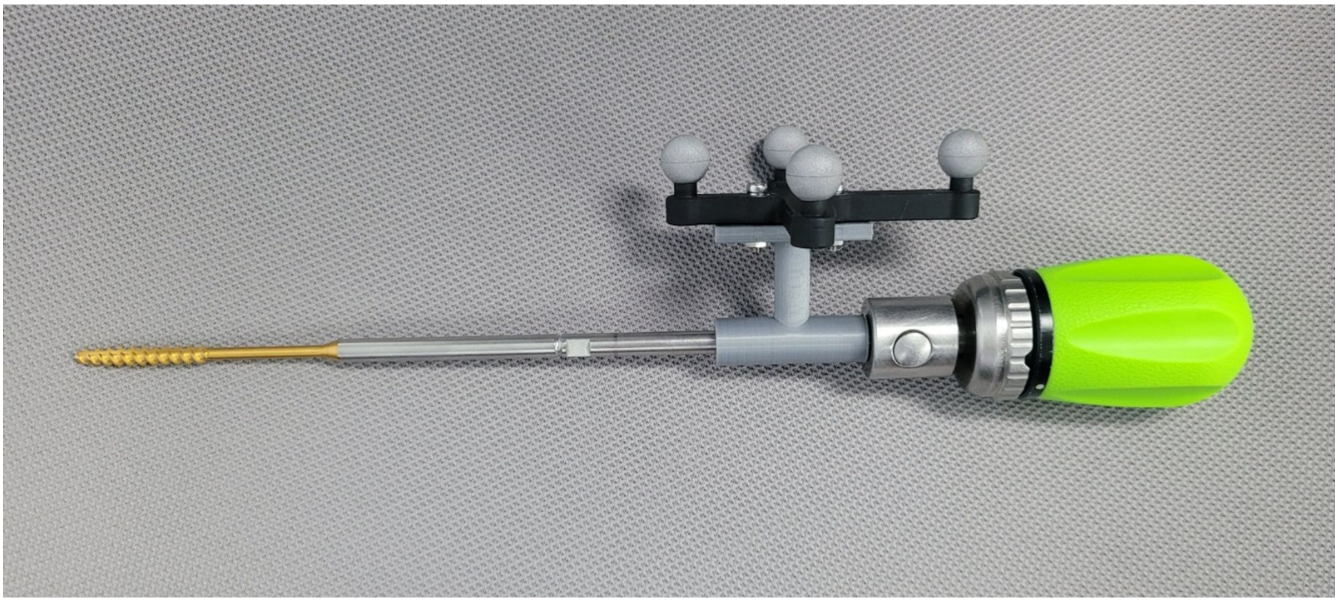

Figure 6. Instrument with a passive-marker adapter used for non-standard and long-instrument calibration.

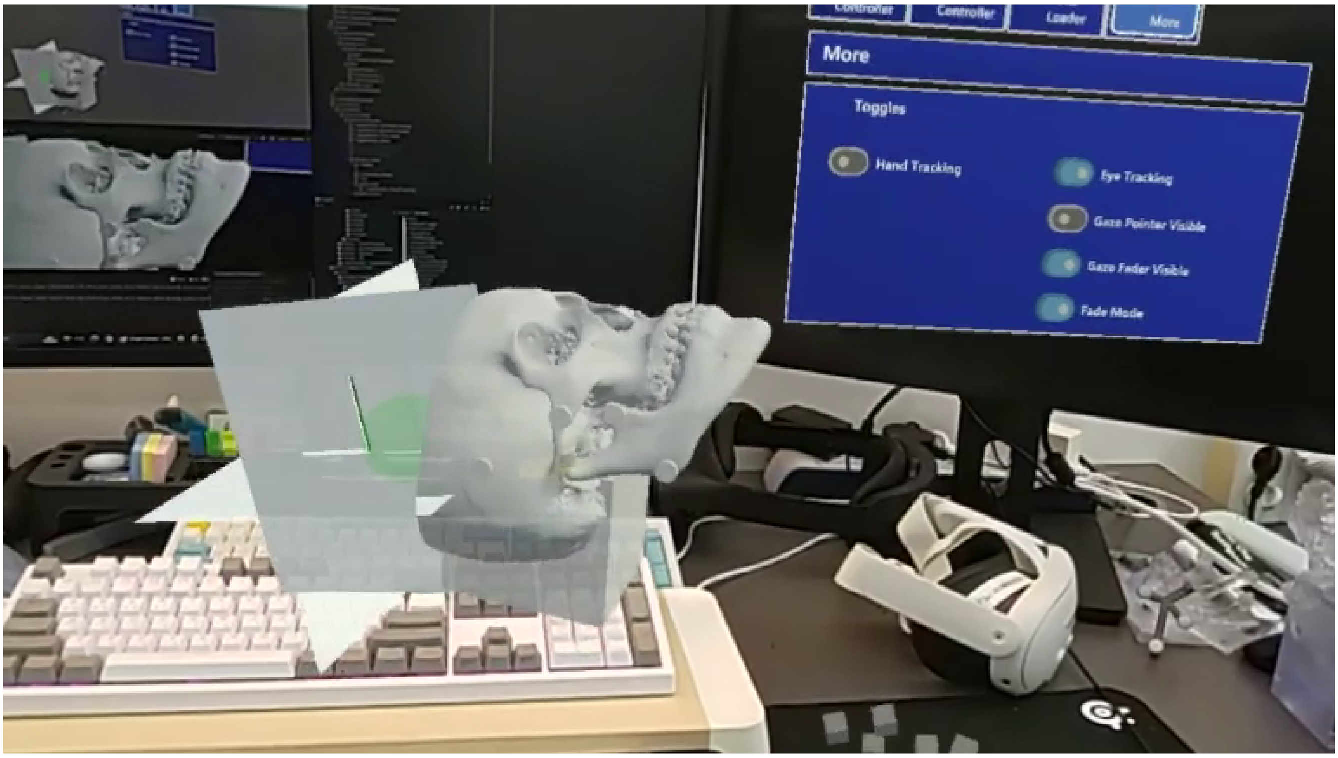

Figure 7. HoloLens spatial presentation with hand- and eye-interaction toggles.

Role, team result, and limits

Team result

The DIGITRACK and Samsung Medical Center research team jointly reviewed the clinical-workflow and requirements context, acceptance criteria, and integration demonstrations.

Limitations

Long-duration robustness, performance optimisation, deployment setup, and packaging were not completed to productisation level. This case does not claim production deployment, use in real surgery, or clinical efficacy, safety, or accuracy.

Collaboration boundary

Clinical workflow and acceptance criteria remain distinct from the development team's tracking, imaging, and XR integration review.

Implementation technologies

HoloLens 2 · Optical tracking · 3D Slicer · Unity · MRTK · OpenIGTLink · Holographic Remoting

Primary capability

3D Geometry & Registration · Medical Navigation & Visualization · XR Application Engineering

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Registered public evidence

No external public link is currently registered.

What to bring

Share the problem, data or sensors, target validation, and schedule. We can define coordinate and evidence boundaries together.

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