Medical Augmented Reality WS 19/20

Project Presentation

Sonification in Tumor Resection (ID 12)

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Clinical background - Tumor resections

Tumor types:

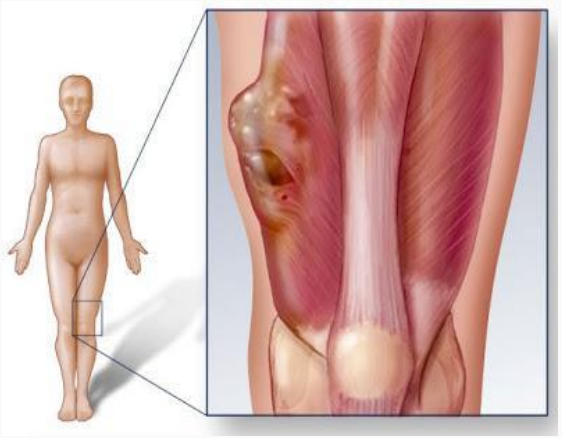
- Bone tumors
- Soft tissue tumors

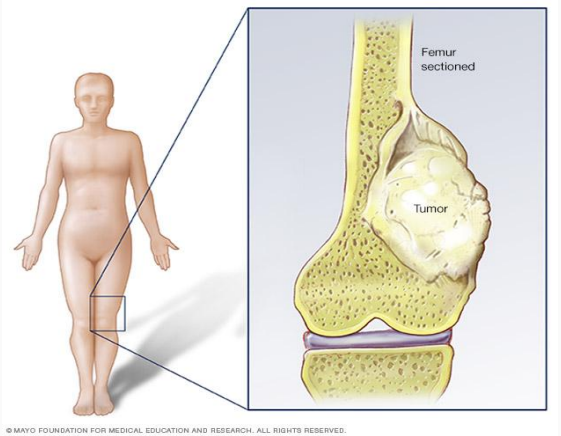
Staging system:

- From latent benign to high grade malignant tumors

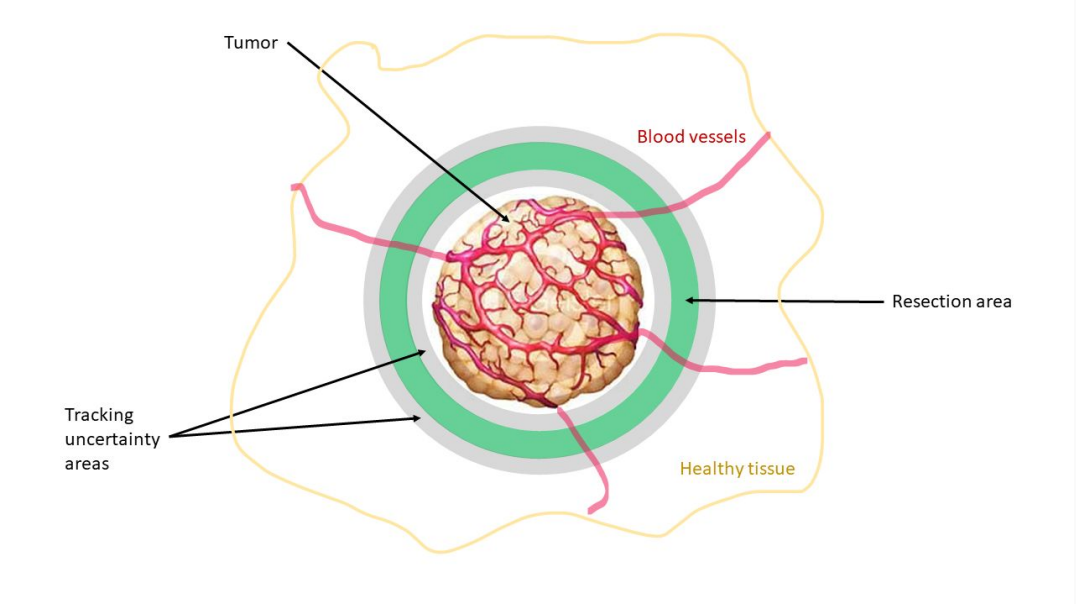
Difficulties:

- Prevention of local recurrences due to residual tumor tissue
  → Otherwise unnecessary re-excision surgeries are needed





Clinical background - surgical margins



Surgical margins:
= surrounding rim of normal tissue

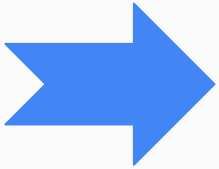
3 margin status:
- Clear margin
- Close margin
- Involved margin

Different areas:
- Resection within the tumor should be cutted
- Tracking uncertainty area

→ Margin should be “clean” after surgery

Project Goal & Features

- **Project goal:** Tumor resection guidance in two ways:
  - Tumor and tool tracking + Visualisation (HoloLens, Markers)
  - Sonification
- **Features:**
  - Uncertainty area
  - Resection area
  - Vascularities and nerves



Should be distinguishable via sonification!

→ Tumor margins should be **visible** and **hearable**!

Challenges

Tracking Error of Hololens

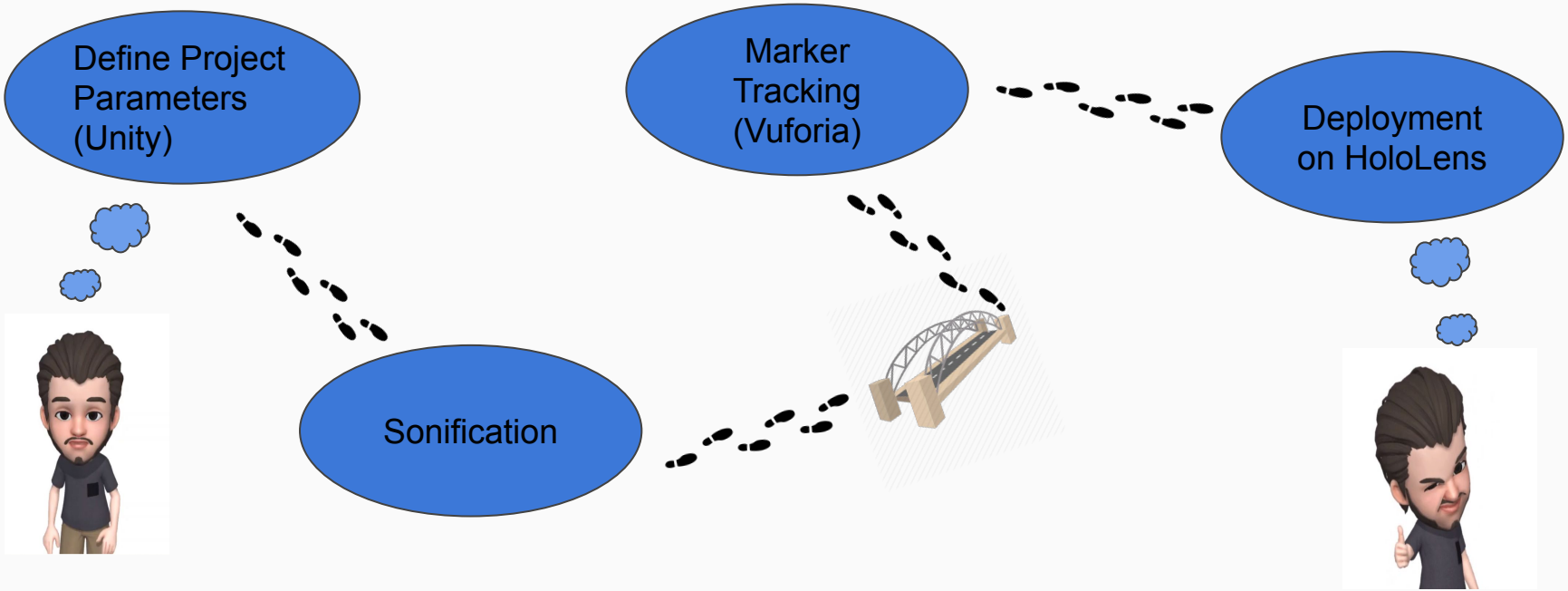
Complex Geometry of the Tumor

Computing distances between tumor and tool

Sonification Dynamics

Realistic approach for Resection

Design - Road Map



Project Plan

09.12- 15.12.	16.12. - 22.12.	23.12. - 29.12.	30.12. - 05.	06.01. - 12.01.	13.01. - 19.01.	20.01. - 26.01.	27.01. - 02.02.	03.02. - 06.02.
Call mentors	Prepare 1. präsentation	Define input parameter (what is necessary to implement the problem) -> find sound samples, 3D model, etc. and import into Unity		Define tracking concept (tumor, instrument)	Improve implementation/sonification	Second protoype try on Hololens	Third protoype try on Hololens (with features, real tumor object, instrument)	Prepare final presentation/demo
Meet group members	Research (medical background)	Get used to coding in Unity -> find and try functions that could be useful for the project		Implement tracking	Tracking of the Tumor		Improve implementation/sonification	
Define interpretation of project	Assign tasks for the christmas holidays	Research -> how to deal with sound in Unity		First protoype try on Hololens (maybe virtual tumor object, but real tracking of the tool)				
Prepare 1. präsentation		Implement first prototype in Unity (Sphere, Tool, Cutting Area, Sonification when tool is moving)						Final presentation

Thank you for listening!

Pictures

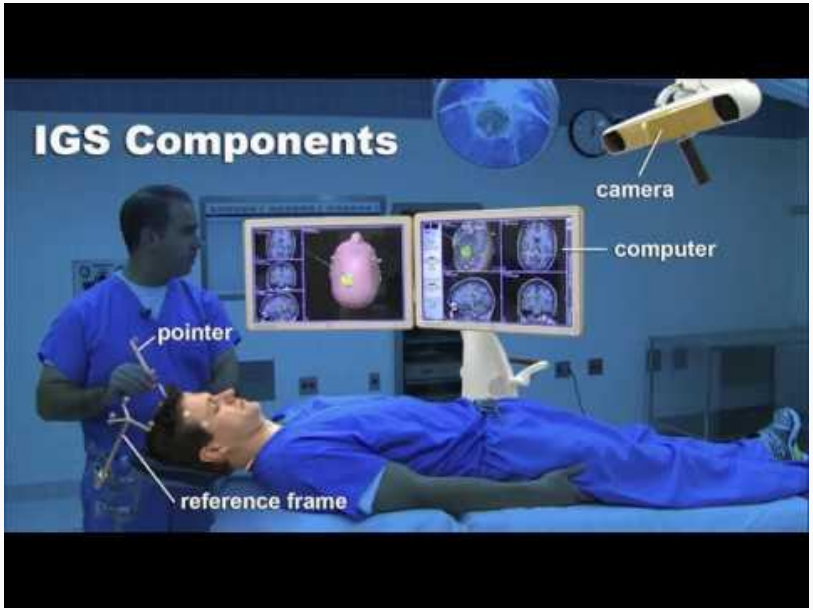
Bone tumor (slide 3):
https://www.google.de/search?biw=912&bih=872&tbm=isch&sxsrf=ACYBGNQYUiS3fT5l9orCwrzz0Cz_bMsUYQ%3A1576369689030&sa=1&ei=GX71XbukAcfZgQaUr4GwBg&q=bone+tumor&oq=bone+tumor&gs_l=img.3..35i39j0j0i30l8.29514.29982..30171...1.0..0.73.201.3.....0....1..gws-wiz-img.....0i19.BP4ZSv8nfGs&ved=0ahUKEwj7lOXasrbmAhXHbMAKHZRXAGYQ4dUDCAY&uact=5#imgrc=SH_67Sv2RqnezM:&spf=1576369708923

Soft tissue tumor (slide 3):
https://www.google.de/search?biw=912&bih=872&tbm=isch&sxsrf=ACYBGNQdGd0m550L6fI-oPGS2yzQoDGWcg%3A1576369720750&sa=1&ei=OH71Xb-2LcGHhbIP3JaW8Ao&q=soft+tissue+tumor&oq=soft+tissue+tumor&gs_l=img.3..0i19l10.105793.107985..108146...3.0..0.83.1202.18.....0....1..gws-wiz-img.....35i39j0i30j0i67j0j0i131.OXSpN9MkZLU&ved=0ahUKEwi_svXpsrbmAhXBQ0EAHVyLBa4Q4dUDCAY&uact=5#imgdii=YODMUWh9PSL47M:&imgrc=zJ4A6Q-YNUb3qM:&spf=1576369818438

Image Guided surgery (slide 5):
https://images.app.goo.gl/WJijgGip52gMDwNU7

Backup slides

Image guided surgery for tumors



Today's strategy: <u>Image guided surgeries</u>

- Instrument is tract
- Screens present location of tumor and instrument (2D and 3D)
- Surgeon must always change his view
  → small hand/arm movements
  → resection inaccuracies

Staging system - MSTS (Musculoskeletal Tumor Society)

MSTS stage	Description	Examples	
		Bone tumor	Soft tissue tumor
1	Latent benign tumor	Nonossifying fibroma, unicameral bone cyst, enchondroma	Lipoma, fibroma, schwannoma
2	Active benign tumor	Chondroblastoma, osteoblastoma, aneurysmal bone cyst	Myxoma, hemangioma, pigmented villonodular synovitis
3	Aggressive benign tumor	Giant cell tumor	Fibromatosis
IA	Low grade malignant tumor contained within its compartment of origin	Parosteal osteosarcoma	Low grade soft tissue sarcoma
IB	Low grade malignant tumor extending beyond its compartment of origin		
IIA	High grade malignant tumor contained within its compartment of origin	Conventional osteosarcoma	Intermediate or high grade soft tissue sarcoma
IIB	High grade malignant tumor extending beyond its compartment of origin		
IIIA	Low or high grade malignant tumor, with metastasis, primary tumor contained within its compartment of origin	Any	Any
IIIB	Low or high grade malignant tumor, with metastasis, primary tumor extending beyond its compartment of origin		

https://books.google.de/books?id=468iAwAAQBAJ&pg=PA33&dq=tumor+resection+procedure&hl=de&sa=X&ved=0ahUKEwj4oauMq7bmAhUTi1wKHZctD0AQ6AEIOzAC#v=onepage&q&f=false

Surgical margins as function of MSTS stage

MSTS stage	Procedure	Examples	
		Bone tumor	Soft tissue tumor
1	Intralesional	Curettage	Piecemeal excision
2	Marginal	Complete curettage of intraosseous tumor, resection of osteochondroma	Shelling out of entire tumor
3	Aggressive benign tumor	Extended curettage, possible wide resection in expendable bones	Marginal resection with adjuvant, possible wide resection
IA	Wide resection	Wide bone resection	Wide soft tissue resection
IB			
IIA			
IIB			
IIIA	Wide resection with metastatectomy if resectable	Wide bone resection with metastatectomy if resectable	Wide soft tissue resection with metastatectomy if resectable

https://books.google.de/books?id=468iAwAAQBAJ&pg=PA33&dq=tumor+resection+procedure&hl=de&sa=X&ved=0ahUKEwj4oauMq7bmAhUTi1wKHZctD0AQ6AEIOzAC#v=onepage&q&f=false

Project plan → 8 weeks until 06.02.2020

Starting point:

- Tumor is a sphere (3D)
- Sonification of distances between tumor and kind of a clinical instrument (with different sounds)
- At first only in Unity (without tracking)

Vision:

- Variable tumor contours
- Sonification of different margins, vascularities and nerves
- Setup with a real tumor phantom and a clinical instrument tracked by Hololenses

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Call mentors	Prepare 1. präsentation	Search for already implemented functions that can help for the project (gesture, voice, ...)		First protoype try on Hololens (without sonification, virtual tumor object)		Second protoype try on Hololens (with sonification, virtual tumor object, instrument)	Third protoype try on Hololens (with features, real tumor object, instrument)	Prepare final presentation
Meet group members	Research	First try with Unity with a tumor and a pen (like "Roll a ball") --> text saying at which area my pen points at		Define tracking concept (tumor, instrument)				Prepare demo
Define interpretation of project	Assign tasks for the christmas holidays	Search for the best sonification programm for our project		Include tracked resection instrument				
Prepare 1. präsentation		get familiar with this sonification programm						Final presentation
		How to get sonification into Unity						
		Research						