Channel Research Day

TETMOST : accessibility to Art for Visually Impaired People

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1 Context

Access to art for VIP

- **Non-visual representation of artwork**
  - Information to keep ?
  - Appropriate interface ?
  - Tactile code to use ?
- **Indoor localization and guidance**
  - What sensors to use ?
  - What interface to use ?
  - How to guide the user ?

VI: 1 700 000
Blind: 207 000

VI: 2 000 000
Blind: 360 000

2 Problematic

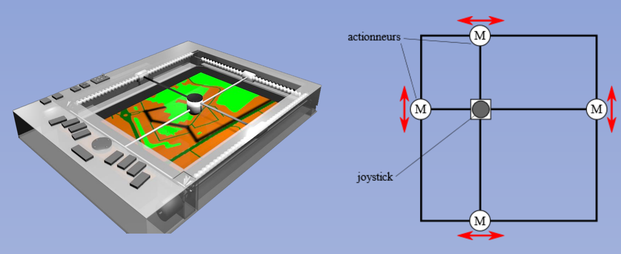
Access to Art for VIP

- Non-visual Art representation → Audio-tactile transposition (5, 6) → Non-visual interface (4)
- Indoor guide → Localization & Wayfinding (7, 8) → Non-visual interface (4)

3 Our approach

4 Interface

- **Force Feedback Tablet** [1] : conveys information through resistance to movement



2 modes:
- **Active** : joystick guides users' finger
- **Passive**: resist or facilitate users' movements

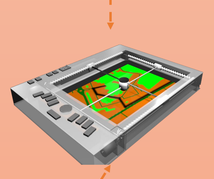
- Benefit from hand's sensory-motor loops → better spatial integration of objects

5 Art Transposition

- Create an intelligible **audio-tactile representation** of a painting [2]

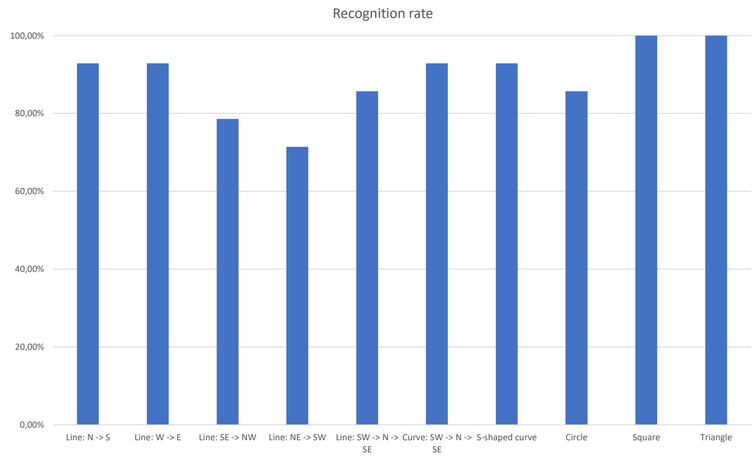
Traditional audio description = **Semantic** (content description) + **Spatial** (position & shape description)

Semantic segmentation



6 Evaluation

- **Preliminary evaluation [3]** → simple movements and shapes comprehension



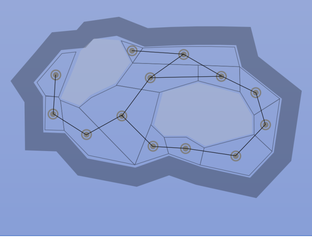
- N = 14
  - 7 congenitally blind
  - 3 late blind
  - 4 blindfolded
- Movements:
  μ = 85,7%; σ = 9%
- Shapes:
  μ = 94,6%; σ =6,8%

7 Indoor Localization

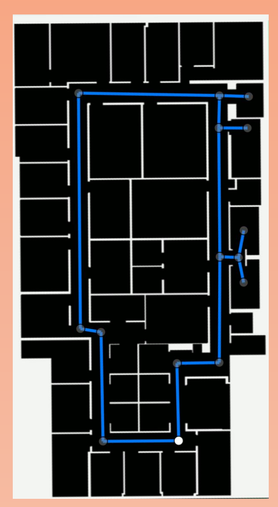
Pinpoint the user's location on a map + **Provide intuitive navigation assistance**

1. **Indoor Atlas** [4]:
   - IMU, Magnetic, WiFi, Barometric
   - Lower accuracy, less constraints
2. **iLocalize** [5]:
   - IMU, Video, Barometric
   - Higher accuracy, more constraints

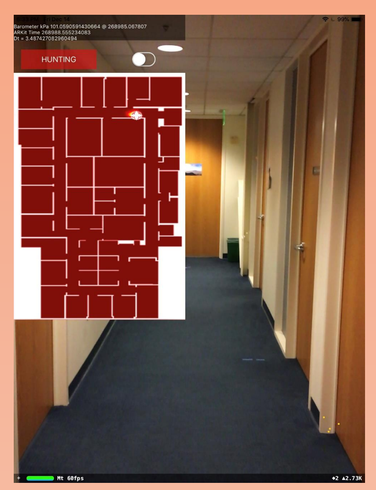
Generate an intuitive navigation graph from the floor plan



8 Evaluation

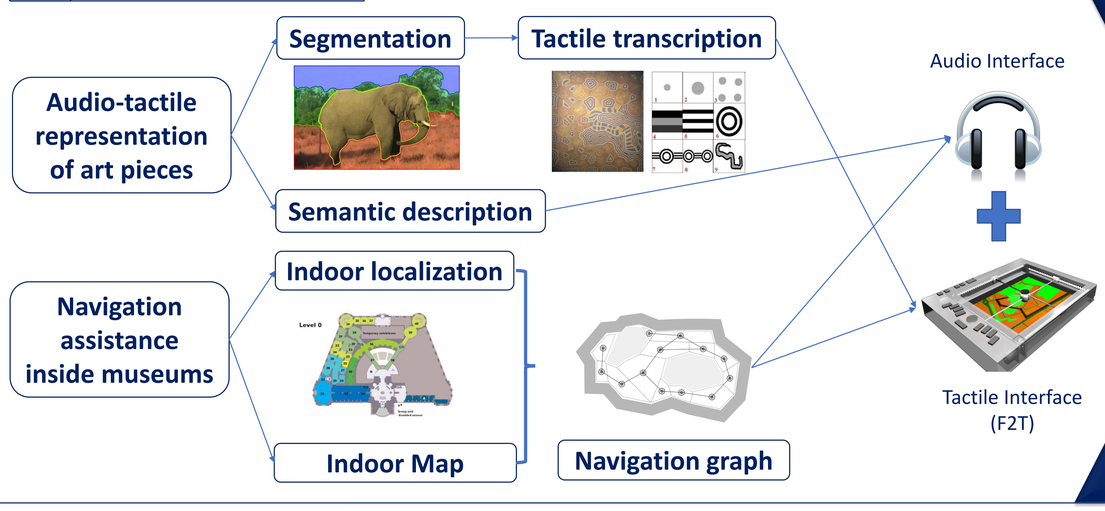


Navigation Graph



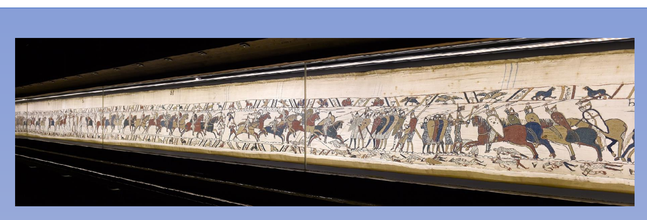
Localization

9 Conclusion



10 Future

Project "Museum Guide" (RIN) with:
- Normandy University
- Museum of Bayeux
- Royal Holloway University
- Contribution: CNRS, Normandie-Lorraine, FAF



- Applied to create an audio-tactile representation of **Bayeux's tapestry**

Improve over TETMOST :
- Map-less indoor localization (Simultaneous Localization and Mapping)
- Better image segmentation and tactile transcription using Machine Learning

11 References

[1] Gay, S., Rivière, M.-A., & Pissaloux, E. (2018). Towards Haptic Surface Devices with Force Feedback for Visually Impaired People. In K. Miesenberger & G. Kouroupetroglou (Eds.), Computers Helping People with Special Needs (Vol. 10897, pp. 258–266). Cham: Springer International Publishing.
[2] Thompson, H. (2018). Audio Description: Turning Access to Film into Cinema Art. Disability Studies Quarterly, 38(3).
[3] Rivière, M.-A., Gay, S., Romeo, K., Pissaloux, E., Bujacz, M., & Strumillo, P. (In Press). NAV-VIR: an audio-tactile virtual environment to assist visually impaired people. In *2019 9th International IEEE/EMBS Conference on Neural Engineering (NER)* (p. 4). San Francisco, California: IEEE.
[4] Haverinen, J., & Kemppainen, A. (2009). Global indoor self-localization based on the ambient magnetic field. Robotics and Autonomous Systems, 57(10), 1028–1035.
[5] Fusco, G., & Coughlan, J. M. (2018). Indoor Localization Using Computer Vision and Visual-Inertial Odometry. In K. Miesenberger & G. Kouroupetroglou (Eds.), Computers Helping People with Special Needs (pp. 86–93). Springer International Publishing.