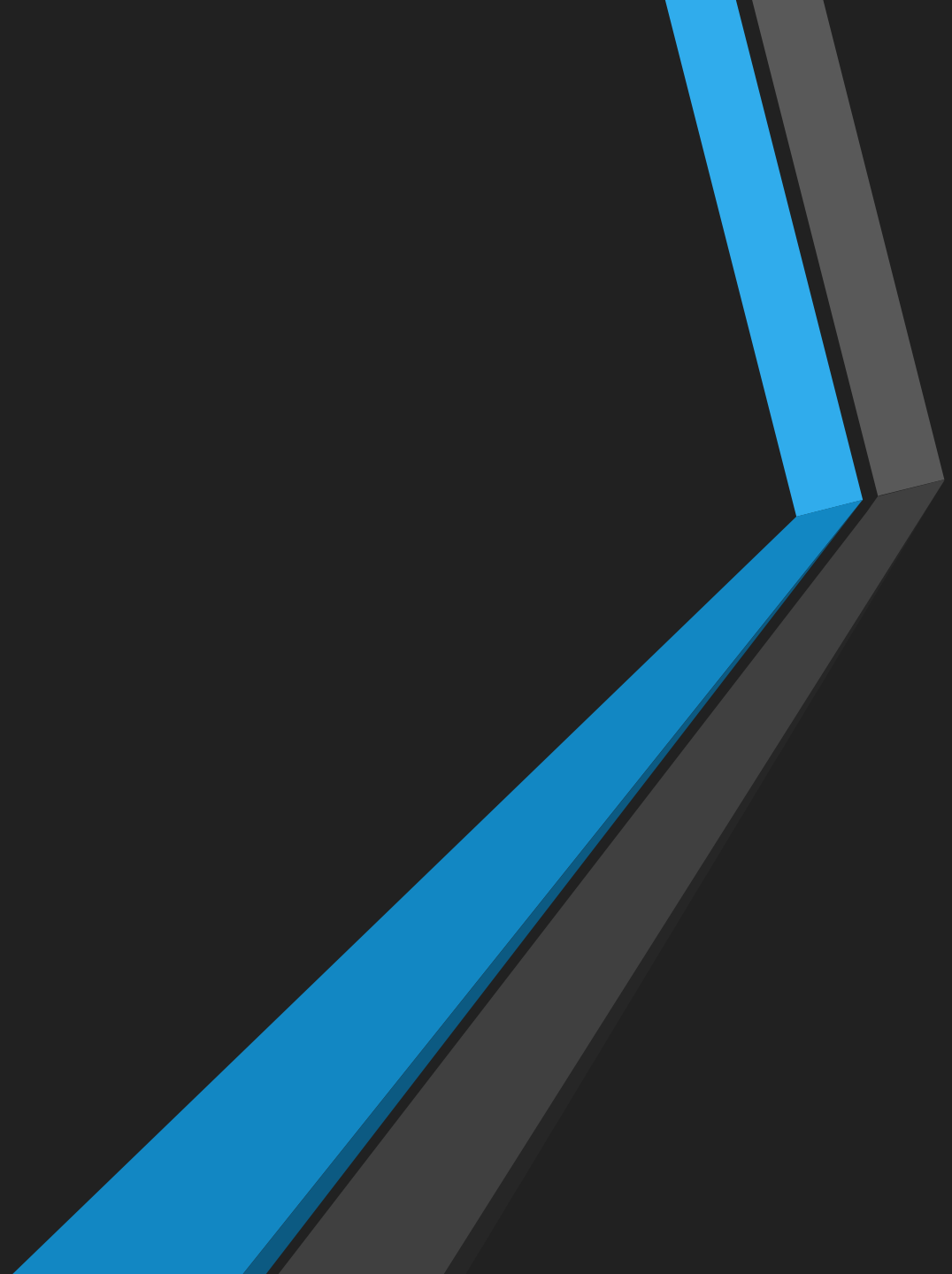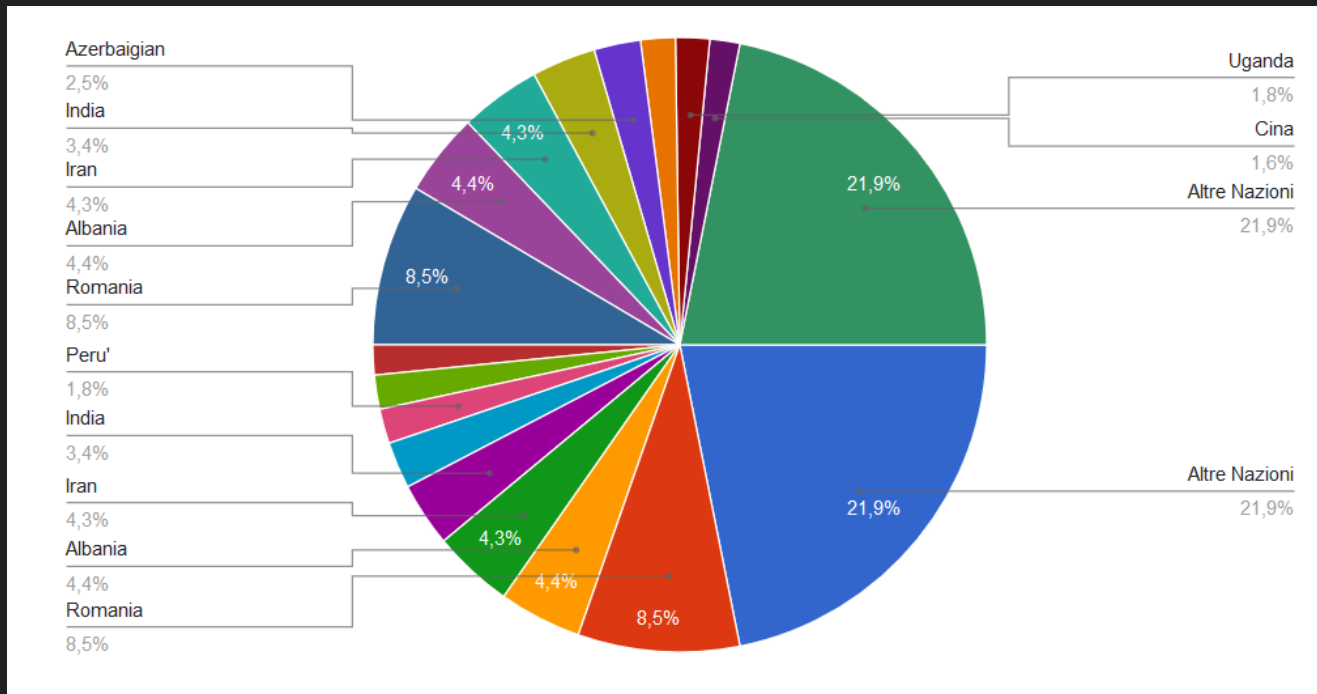# Smart Museum

Design Project

Sapienza had more of 10.000 foreign students in 2018 from a variety of countries:

It emerged that the majority of visitors of the museum are students
both from Sapienza and outside

The idea, visitator view:

- The service will recognize the room in which the user is thanks to BLE Beacons
- The descriptions of the works of art present in that room will be shown.
- Digital content associated with the work will also be available (such as audio description, video etc ...).
- The system will also allow users to get automatic translation of the information retrieved.
- There will be customized itineraries inside the museum.

Anand

- 25 years old
- Lives and studies in Italy
- From Mongolia
- Studies Linguistic

Anand decided to leave Mongolia and start university in Italy

He is arrived in italy one week before lessons begins and one day he decided to explore Sapienza campus and goes to the musem

He is not pratical with italian history and with italian language. He knows a bit of english but he definitevly prefers his mother lenguage

Thanks to the SmartMuseum app he can know in which room of the museum he is, he can retrive informations about sculptures in the room, and learn a bit of related history

The app provides automated translation of the descriptions and custom guided tours to explore only a desired part of the museum

The idea, curator view:

- Monitor traffic and crowding inside the museum
- Optimize arrangement of artworks to avoid crowded rooms
- Track user movements for further advanced analysis
- Sell digital pay-per-view content
- Provide custom paths inside the museum according to some special criteria
- Monitor the weather conditions of each room through the dashboard

Gabriella

- 54 years old
- Lives in Italy
- Museum Curator
- Has studied Cultural Heritage

As Museum Curator, Gabriella wants to make the museum accessible and technological... The Internet of Things comes to her hands

Thanks to the Dashboard, Gabriella can monitor rooms, including temperature, humidity and overcrowding

So he begins to rearrange the artworks according to a more balanced path

Now the rooms have a balanced flow of visitors

The interactivity of the museum makes visitors happy and they spend a visit having fun and learning

The experience is so pleasant that people starts to recommend the Sapienza museum, so number of visitors grows
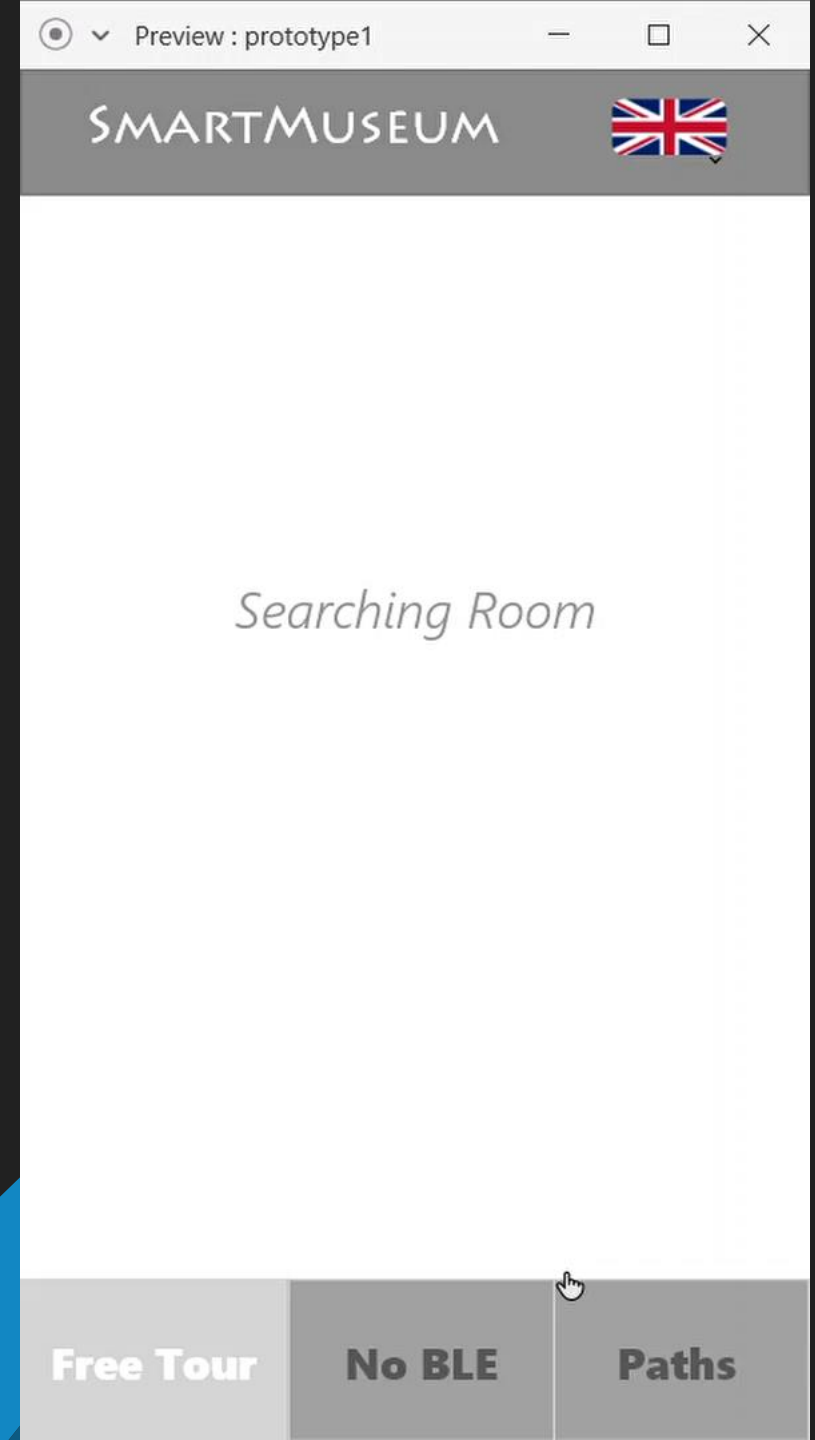
User Centered Design

1. Some sample users tested the prototype
2. Feedback: The app is easy to use but I want to use the it even without Bluetooth
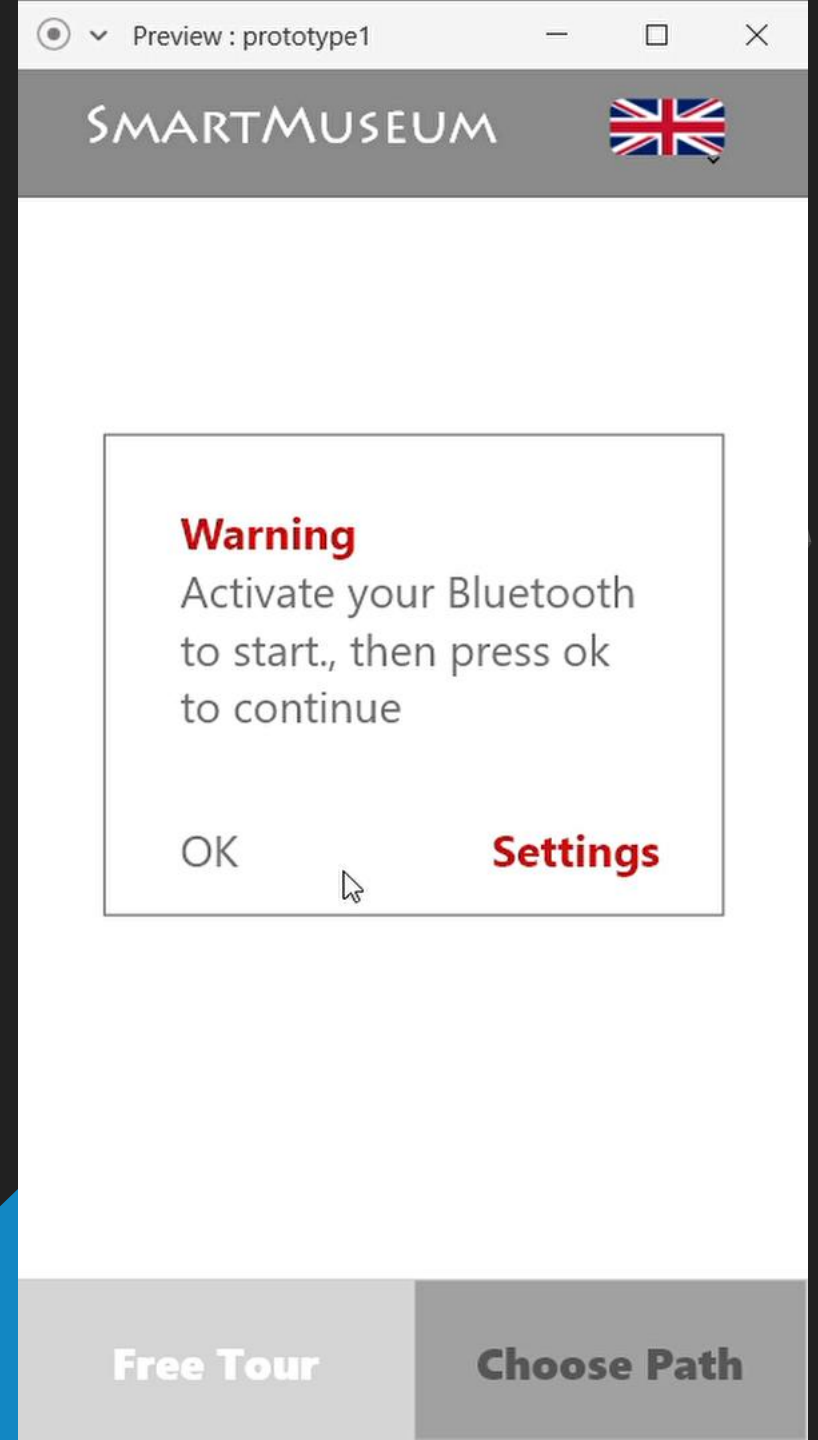
User Centered Design

1. Some sample users tested the prototype
2. Feedback: The app is easy to use but I want to use the it even without Bluetooth
3. We added the manual selection of the room
4. Test users approved (thanks mum)

Possible future developments:

- integrate an augmented reality engine to make the tour more interactive

- Provide audio broadcasting to a group of users to implement live tour with a real guide using the app, replacing old radio devices provided by the majority of the museum nowadays.

- Do not force museum to use BLE beacons but provide a variety of oracles like QR codes, AR tags or swipe among rooms for museum with forced routes.

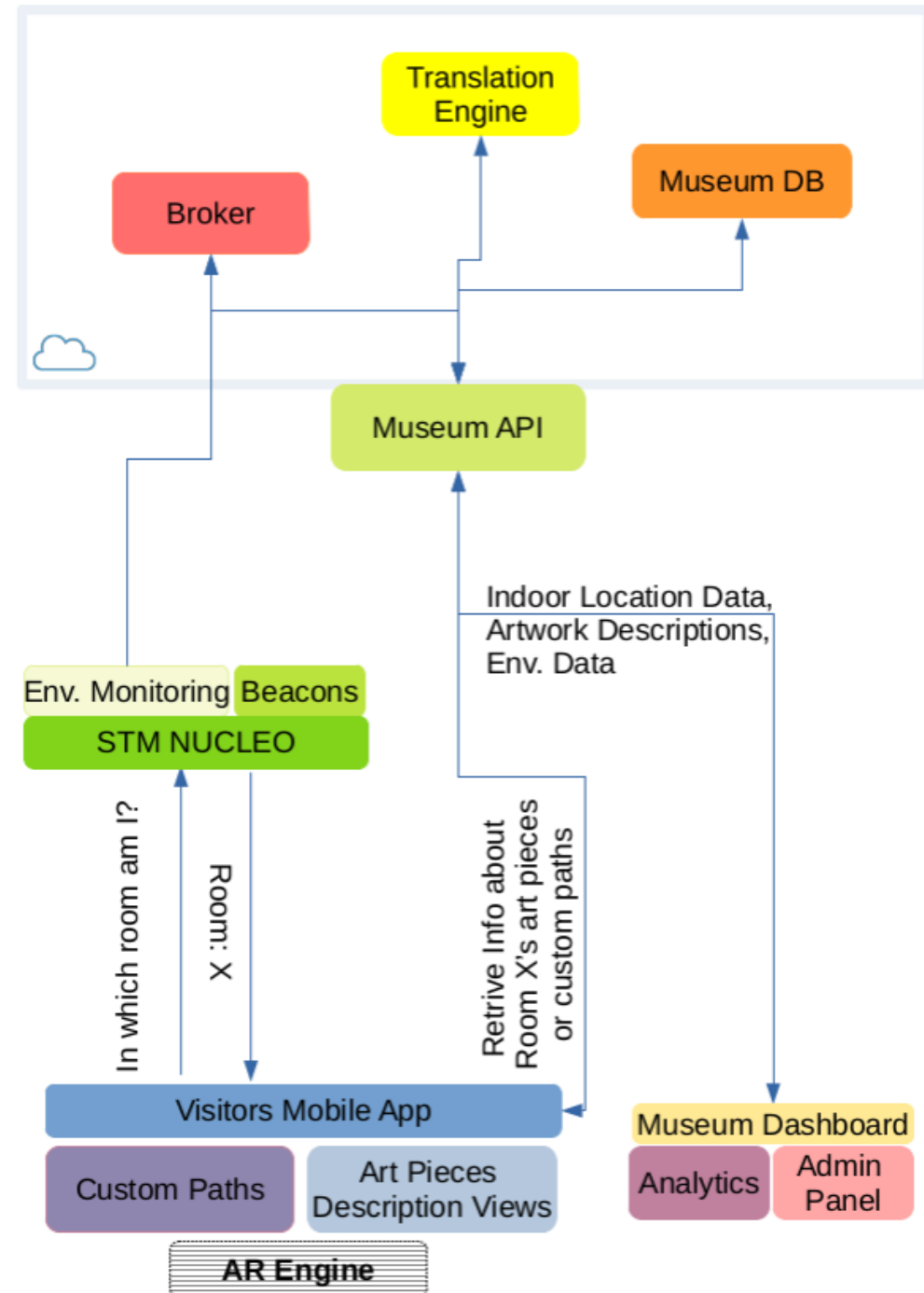- Integration with other classmate projects.

Smart Museum

Architecture Project

Components

- Mobile App for Visitors

- Web Dashboard for Museum Administrators

- Microservice Oriented Backend

- Bluetooth Low Energy Beacons for Indoor Monitoring

- Periodic LoRaWan Messages about Indoor Environment Condition

Microservices and API

- Make it easier to scale up the development effort
- Services can be deployed independently of each other
- Fault isolation
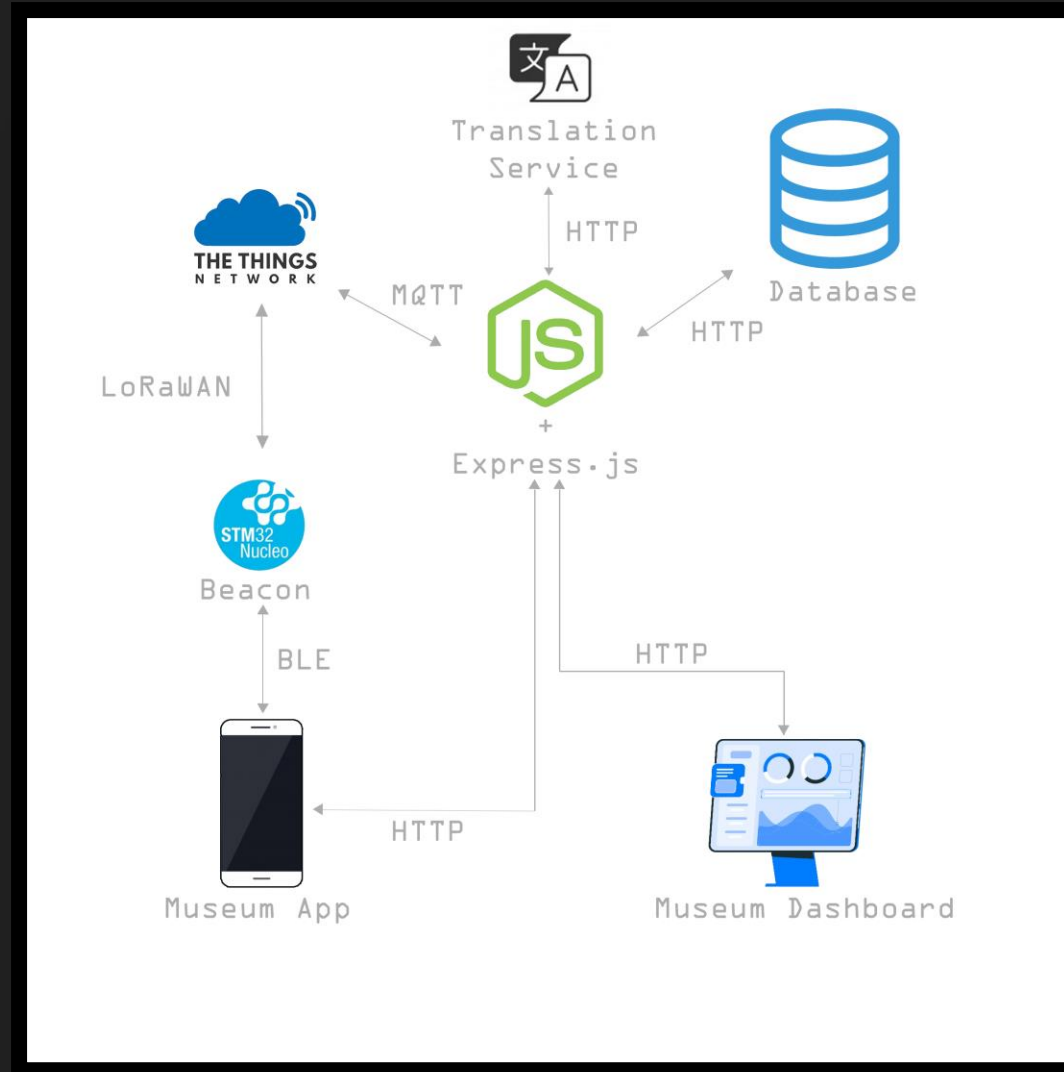- Integration with external services
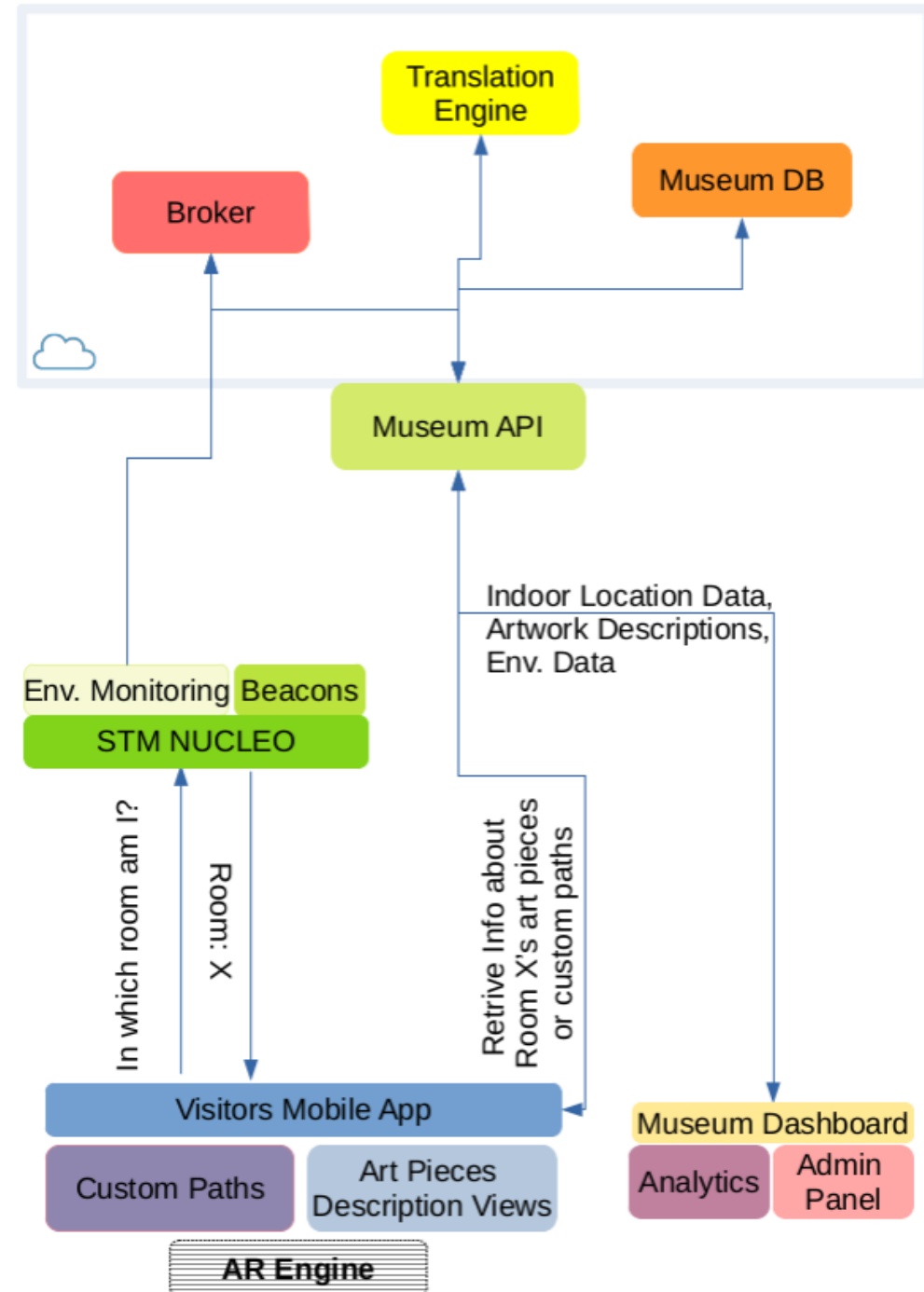
App and Dashboard

- Indoor position and indoor environmental monitoring
- Custom paths
- Digital guided tour
- Integrations possible (AR, personnel organization ...)
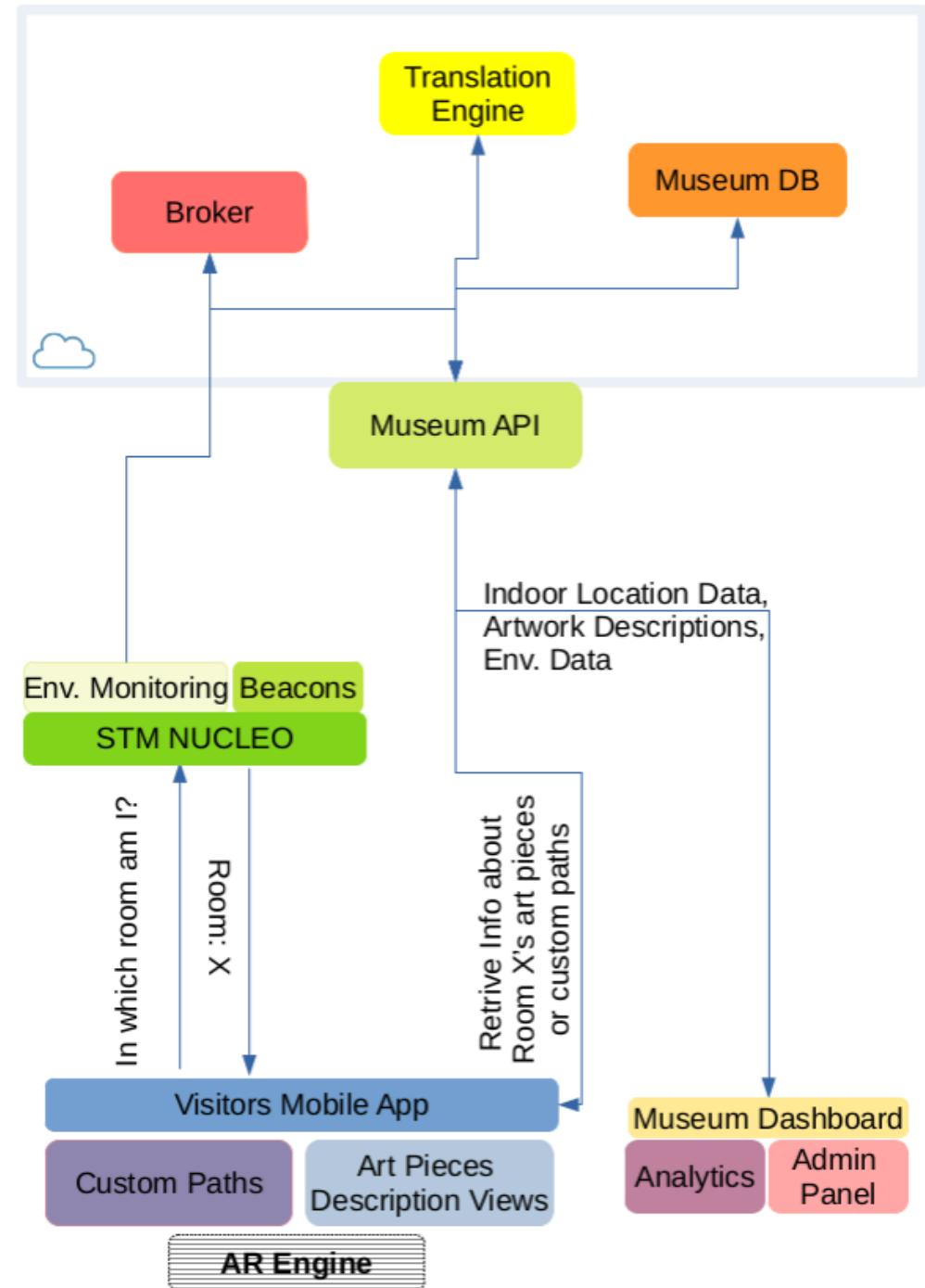
Components Communication

Solution Evaluation

- Hardware and Sensors

- Storage Requirements Estimation

- Cloud Costs

- On Premise Costs

- Experimental Solution Costs

Assumptions

- Open Source project

- No development costs (community works for free or <u>for extra point at IoT course</u>)
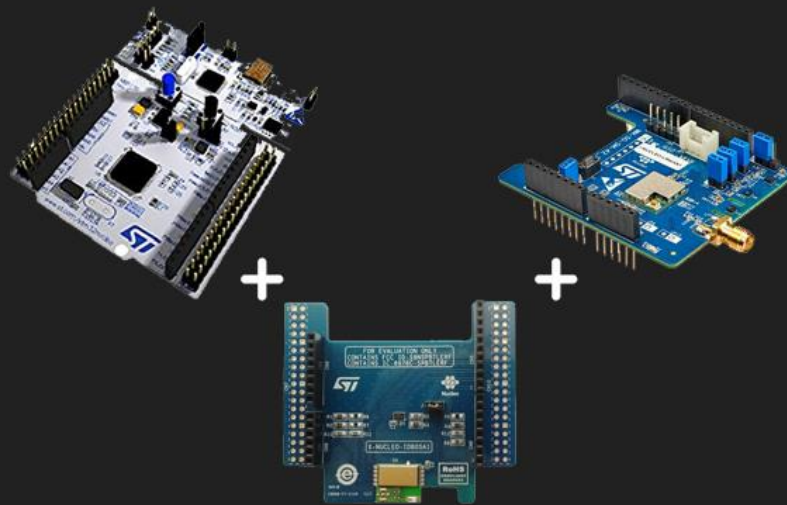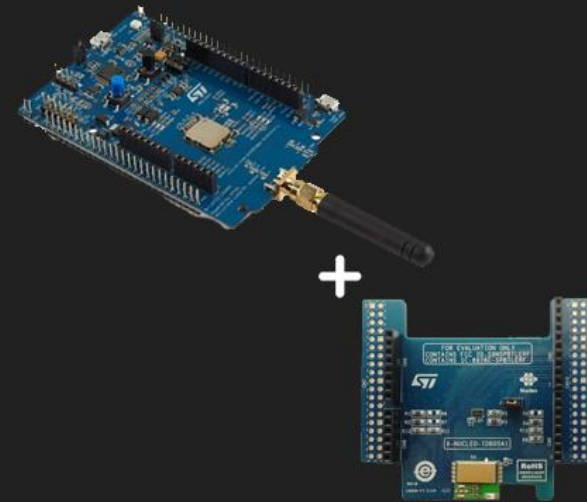
Covid-19 Tolerant Testing

- Test indoor environment monitoring with IoT-Lab Testbed

- Simulate Beacons with a PC supporting Bluetooth

- Other test process as usual

Hardware

- Nucleo + BLE extension + Lora Extension

- Lora Nucleo + BLE extension

Storage Requirements

- Data Model

- Technology

- From BSON specs to Approximation

```
{
Name: "David",
author: "Michelangelo Buonarroti"
Descriptions: [ {"it" : "Il David è una scultura realizzata in marmo da ..."}, {"en" : "David is a masterpiece of Renais
Images: {presentation:BLOB, others: [BLOB, BLOB, …]}  ,
Audios: [{language: "it", tape:BLOB}, {language: "eng", tape:BLOB}, ...] ,
Videos: [{title:"video1", video: href},{Title:"video2", video: href2}, ... ] ,
Room: 2 ,
Available: True , //(for operas borrowed to other museums or currently non available)
OnTrip: False , (for operas borrowed to other museums)
}
```

Cloud Costs

- Comparison between three major providers (AWS, Azure, Google Cloud)

- Google is the most expensive

- AWS and Azure are competitive

- Best solution is Hybrid: Storage on AWS S3 and Middleware/API on Azure App

On Premise Costs

- Could InfoSapienza give us infrastructure and support?

- If yes and with a cost minimum wrt the already existing infrastructure, maybe this might be a good road

Experimental Solution Costs

- App hosted on Raspberry PI Cluster with docker and Kubernetes

- Low Power Consumption: 0,57 kwh for 4 boards at 400% CPU (24h usage)

- Atlas as DB service with M0 Tier (free tier)

Thank You For The Attention

Detailed Description on GitHub
github.com/nicoDs96/SmartMuseum