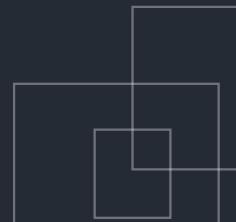


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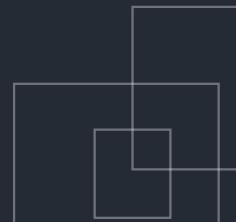
- 1 The Problem
- 2 The Solution
- 3 Look at M.E.
- 4 Evaluations
- 5 Missing Features



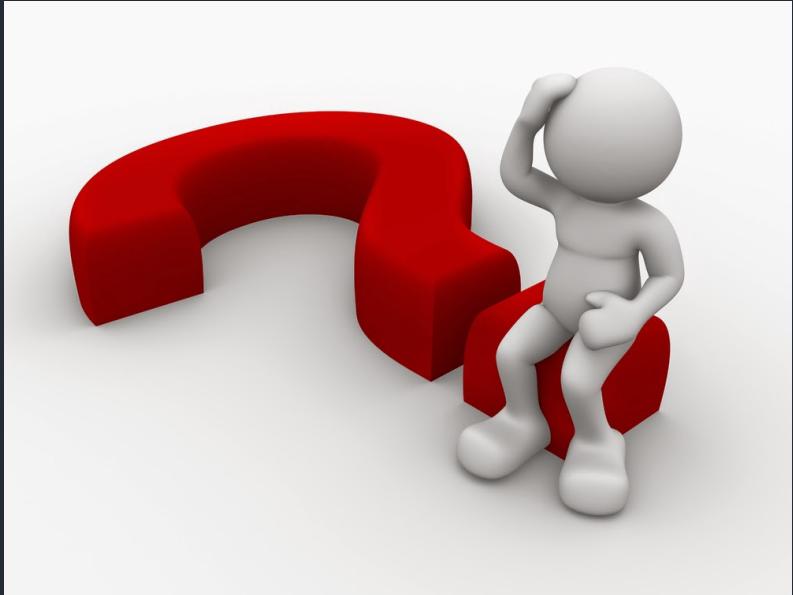
A graphic element consisting of several blue-outlined rectangles and squares of varying sizes, some overlapping, creating a sense of depth and perspective.

1

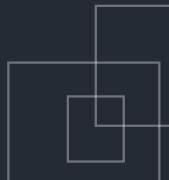
The Problem



The Problem



Museums are great places to lose yourself into history and to learn things that you would not discover otherwise, but most of the times, the large number of different art pieces scattered in the whole museum might be a little overwhelming for a new visitor. This may badly influence his experience.



The Problem

Moreover, in big museums such as Arte Classica Museum, it may prove difficult for the museum staff to guarantee the security of the statues and the visitors. This means that the museum is forced to deploy a large group of employees to keep security on check.



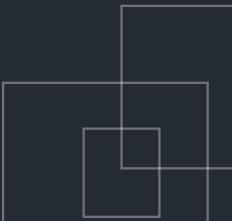
Existing Approaches



To address these problems as of now museums provide audio/video guides for the visitors but they are usually expensive and might not guarantee an uniform service. While for the security, the museum usually has a person for each important room that need to be controlled.



The Solution

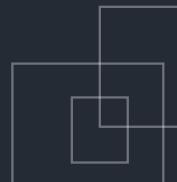


Look at M.E.



Our solution to these problems is Look at M.E.!

The idea of this project is to improve the experience for the museum visitor by guiding him, making sure he fully enjoys all that the museum has to offer. On the activation through a button the lighting in the room will create a light-guided path for the visitors to follow, while also giving info about the art pieces through speakers.



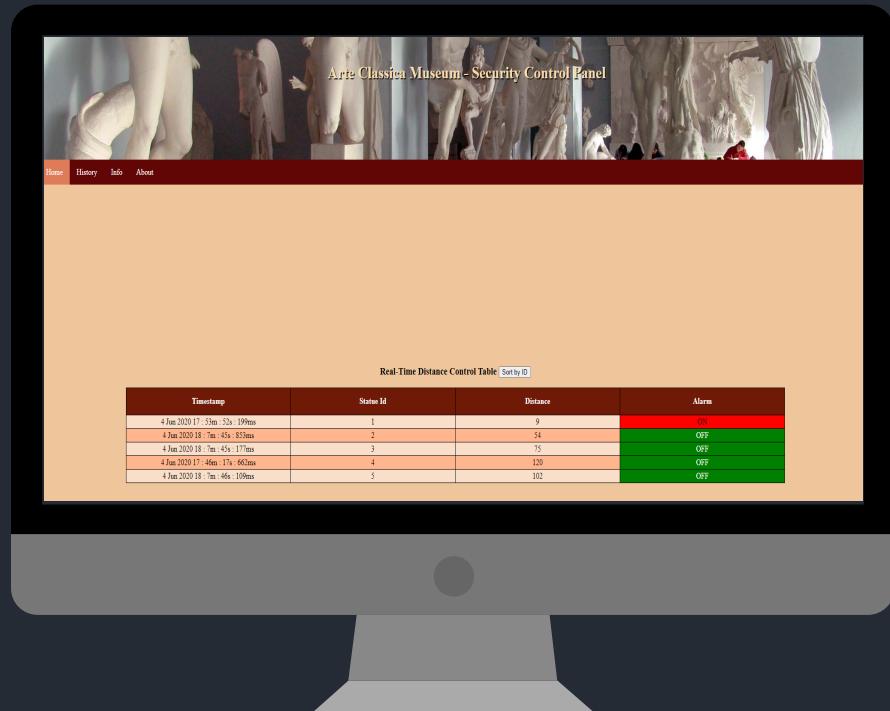
For the visitors



Our product offers two different type of outputs; one aimed to the museum visitors and one for the museum curator.

For the visitors in fact, on activation, a light-guided tour that sequentially light up all the statues in the room and audio output to give visitors additional informations on the art pieces.

For the Security Staff

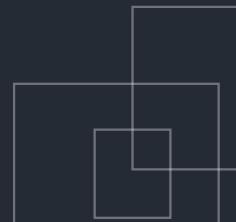


For the curator we will create a table that shows in real time the distance from the statues of the museum visitors, to make sure that no one is getting too close to an art piece. This will help keep the statues and the users safe.

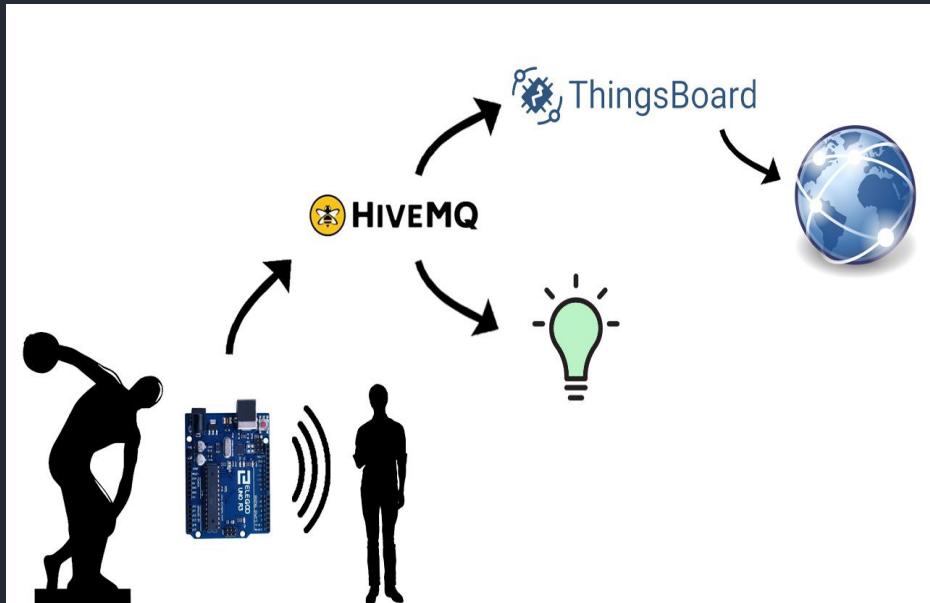
Also, a telegram bot will send an alarm every time there is an infraction.



Look at M.E.



The System



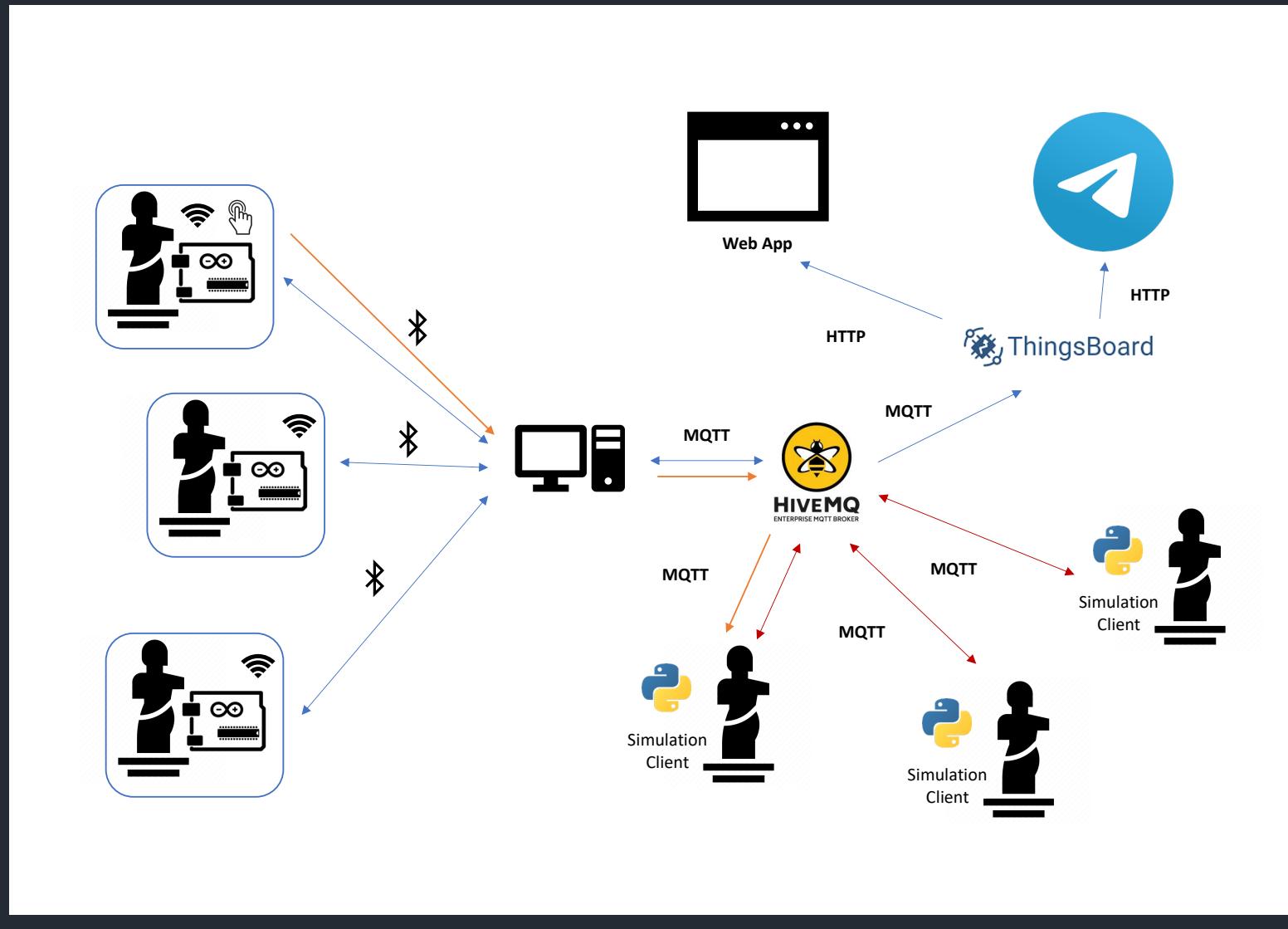
Architecture

The system is composed of the board at which the several hardware components are attached. Through the sensor, we can detect the distance from the statue of the user. The informations are then sent to the HiveMQ broker and forwarded either to Thingsboard or to the topic that the clients are subscribed to.

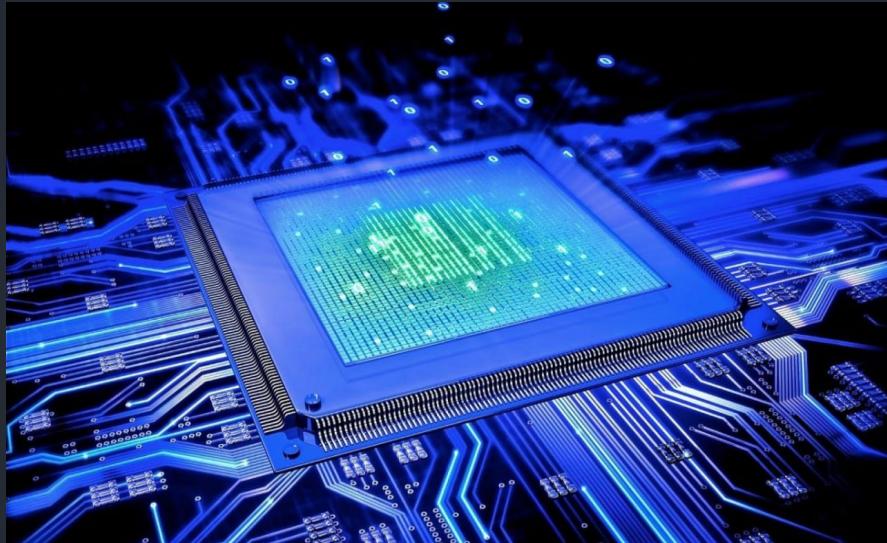
Finally from ThingsBoard, we collect the data to show in our web app. These are managed both locally on the HTML and via rule chain in Thingsboard.

The System

Network Diagram



Hardware



Overview

Look at M.E. is built in an Elegoo UNO R3 board in which we implemented an HC-SR04 ultrasonic proximity sensor to determine whether a visitor is in the “attention area” for each statue. Also, we will use a button to trigger the changing of the lighting and sound of the room to create for the user a guided tour in the room.

Hardware

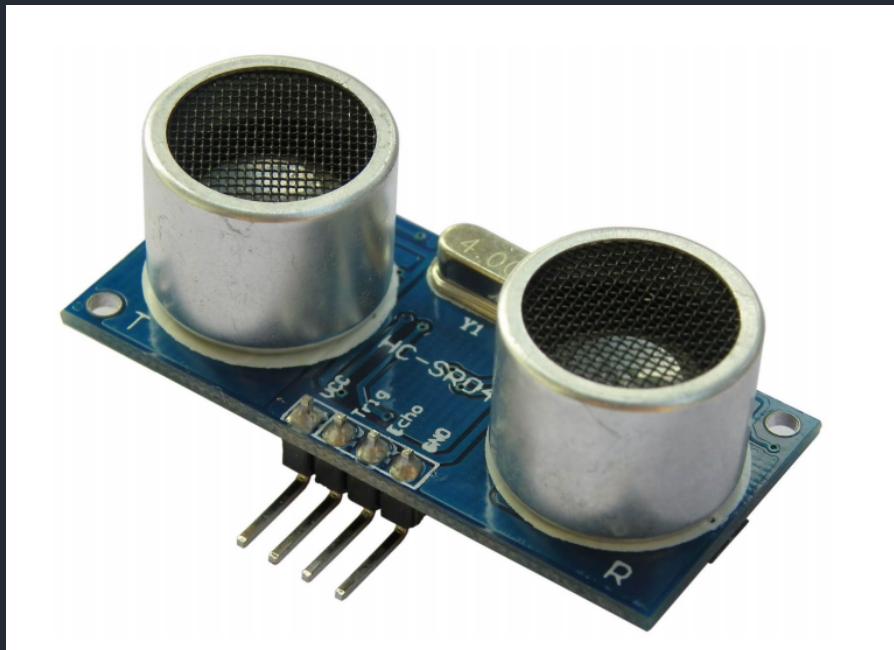
Elegoo UNO R3

The ELEGOO UNO is a microcontroller board based on the ATmega328 (datasheet). It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with an AC-to-DC adapter or battery to get started.



Hardware

The HC-SR04 proximity sensor



The HCSR04 ultrasonic sensor uses sonar to determine the distance to an object like bats or dolphins do. It offers excellent noncontact range detection with high accuracy and stable readings in an easytouse package. It operates in a distance range going from 2cm to 400 cm. Its operation is not affected by sunlight or black material like Sharp rangefinders are (although acoustically soft materials like cloth can be difficult to detect). It comes complete with an ultrasonic transmitter and receiver module.

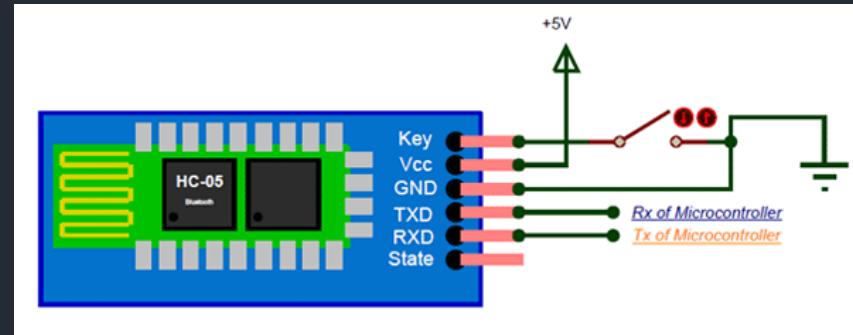
Hardware

HC 5 Bluetooth module

The HC-05 is a module which can add two-way (full-duplex) wireless functionality to projects. You can use this module to communicate between two microcontrollers like Arduino or communicate with any device with Bluetooth functionality like a Phone or Laptop. The module communicates with the help of USART at 9600 baud rate.

External Hardware

Also, we have some hardware external to our board, for example the light and sound system that our application will use to express its full potential. In fact this will subscribe to the topic in our broker so that on a new trigger message the guided tour will start. These are external since we are not implementing them on the board but must be connected to our broker in order to receive the values that trigger them.



Software



Arduino IDE

The Arduino Integrated Development Environment - or Arduino Software (IDE) - contains a text editor for writing code, a message area, a text console, a toolbar with buttons for common functions and a series of menus. It connects to the Arduino and Genuino hardware to upload programs and communicate with them.

The message area gives feedback while saving and exporting and also displays errors. The console displays text output by the Arduino Software (IDE), including complete error messages and other information.



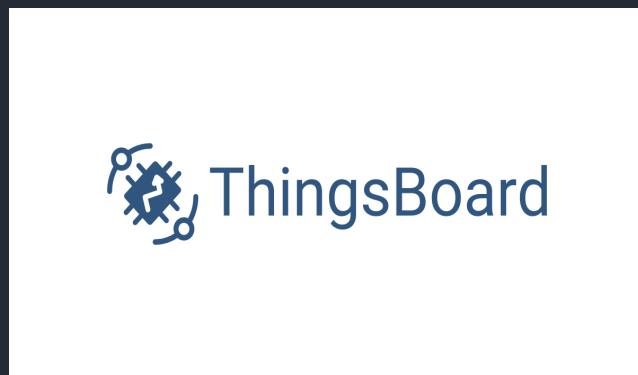
Software

MQTT

MQTT stands for MQ Telemetry Transport. It is a publish/subscribe, extremely simple and lightweight messaging protocol, designed for constrained devices and low-bandwidth, high-latency or unreliable networks. The design principles are to minimise network bandwidth and device resource requirements whilst also attempting to ensure reliability and some degree of assurance of delivery. These principles also turn out to make the protocol ideal of the emerging “machine-to-machine” (M2M) or “Internet of Things” world of connected devices, and for mobile applications where bandwidth and battery power are at a premium.



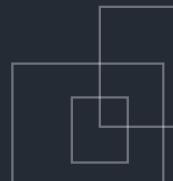
Software



HiveMQ and Thingsboard

HiveMQ is a MQTT broker and a client based messaging platform designed for the fast, efficient and reliable movement of data to and from connected IoT devices. It uses the MQTT protocol for instant, bi-directional push of data between your device and your enterprise systems.

ThingsBoard is an open-source IoT platform that enables rapid development, management and scaling of IoT projects. Its goal is to provide the out-of-the-box IoT cloud or on-premises solution that will enable server-side infrastructure for your IoT applications.



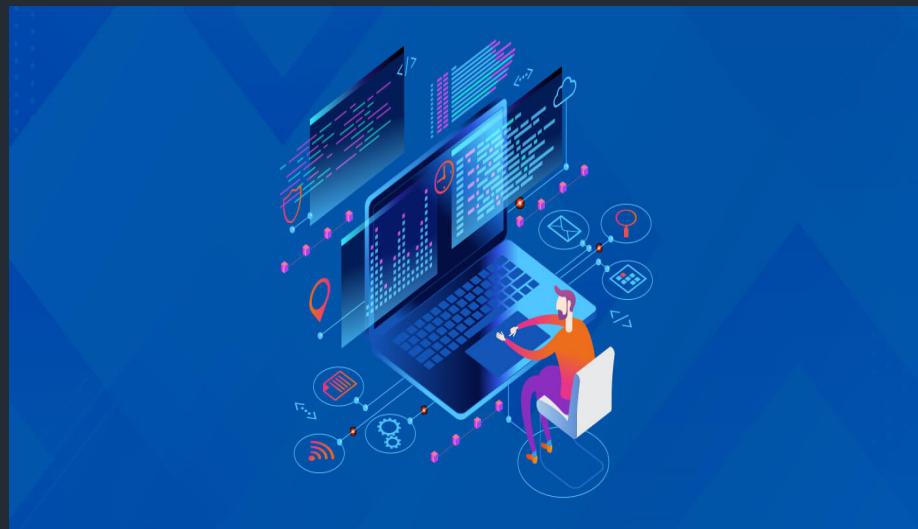
Software

Other Software Components

Coolterm - CoolTerm is a simple serial port terminal application. We will use it to have a better control on the terminal and to create a textfile that will be used to send the publish message to the broker.

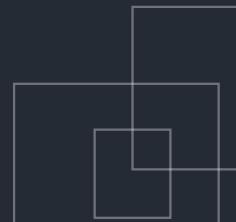
Python Scripts - using the python scripts we will connect to the devices in Thingsboard and will publish the text file that contains the data in JSON format. Moreover, we will use as an example 3 different python scripts that simulate clients that subscribe to the correct topic in the broker.

Telegram Bot - we implemented via Thingsboard an integration to a Telegram bot that sends a message when an infraction is in act giving also the ID of the concerned statue.





Evaluations



User

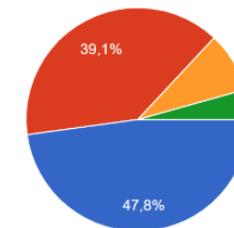
User Point of view

To help museum curators and visitors of “Museo dell’Arte Classica - Sapienza” we created “Look at M.E.”. The strategic point of our project is the involvement by the user in a visual and sound experience that can change the point of view on the works of art.

From the user point of view, what stands out from the survey is that the experience sometimes can be a little invasive, in fact we can see from the chart below that the 40,9% of them believe that. Also, we can see that for several users the whole experience shouldn't last longer than 10 minutes.

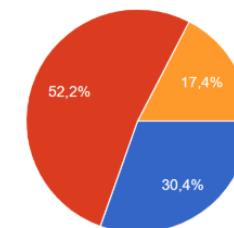
Do you believe that "Look at M.E." could be a little invasive in your visit?

77 risposte



How long do you think the whole experience should last?

77 risposte



Technical



Technical Point of view

From the technical point of view, the factors we evaluated during the project are:

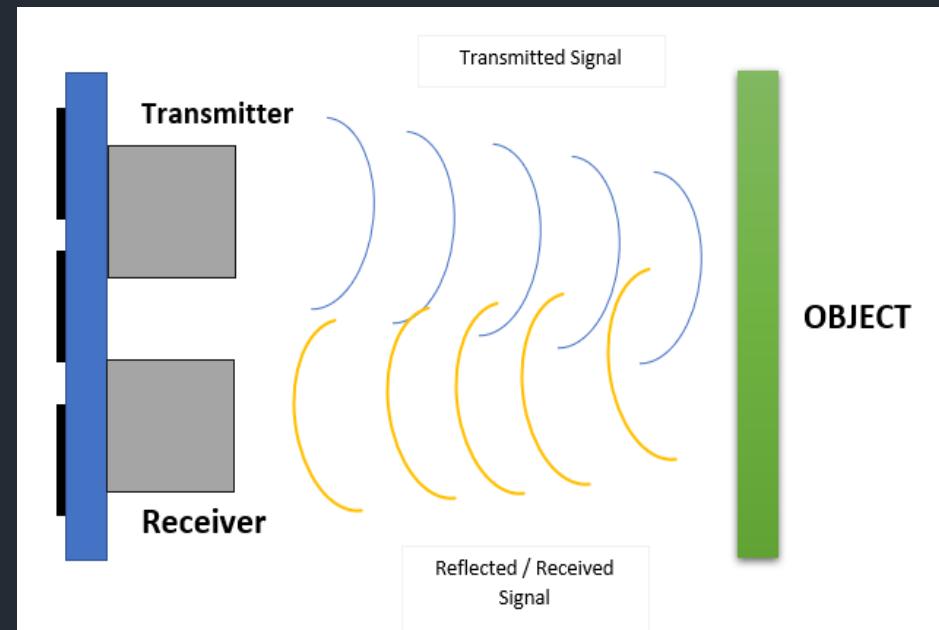
- **Responsiveness** of our project, i.e. how long it takes for the system from edge to cloud to perform
- **Accuracy** of the proximity sensors

Technical

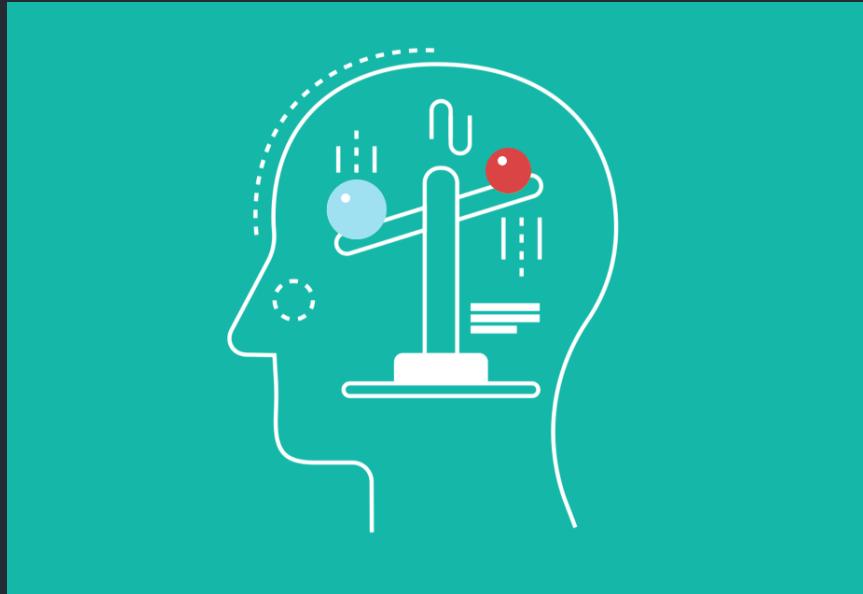
Accuracy

The proximity sensor has proved to be highly precise in the ideal case where there the transmitter is staying still.

A problem where some measurements wrongly gave as result 0 caused by a board movement that made impossible for the receiver to get the reflected signal. As of now we addressed this issue by ignoring return values of zero for the publish to the broker

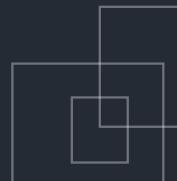


Technical



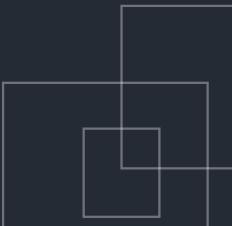
Responsiveness

Finally the responsiveness of the project is one of our main goal, testing each component separately and together, we empirically proved that the entire system takes no longer than units of seconds to perform the requested tasks both for the virtual light-guided path and to inform the security staff of the museum through the Telegram Bot and the web application, if a visitor stepping too close to a statue.

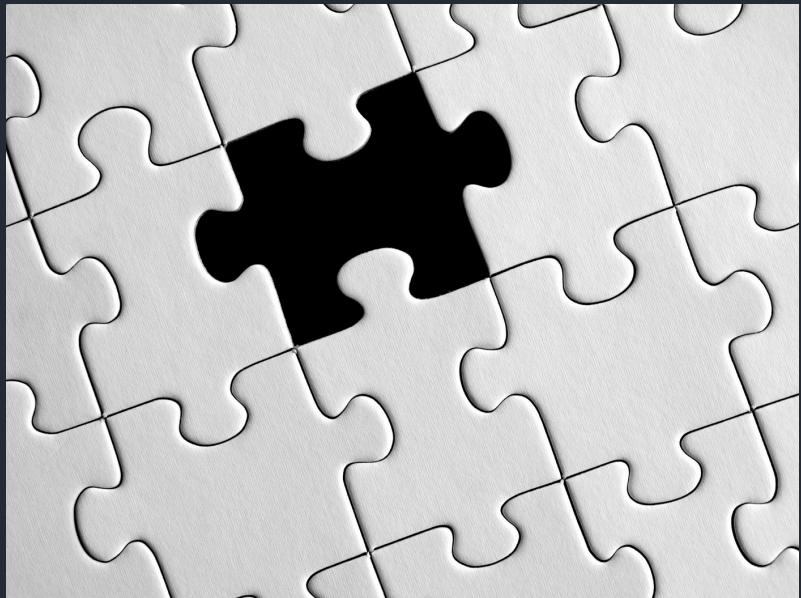




Missing Features



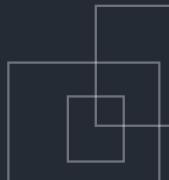
User



What's left out

Unfortunately, we weren't able to replace the simulated clients with the real hardware due to not having it.

For this, we couldn't distribute surveys in order to monitor the scale of satisfaction of the museum's visitors, once deployed the complete project.





Thanks !