HUSH: Deep Learning and Augmented Reality as a tool to explore the naturalistic richness of urban areas

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3 April 2019

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Introduction to HUSH

Goals of the project

- **Valorize!**

  The geo-naturalistic heritage that surrounds the historical center and artistic components in urban areas

- **Involve!**

  Citizens and tourists as scientists

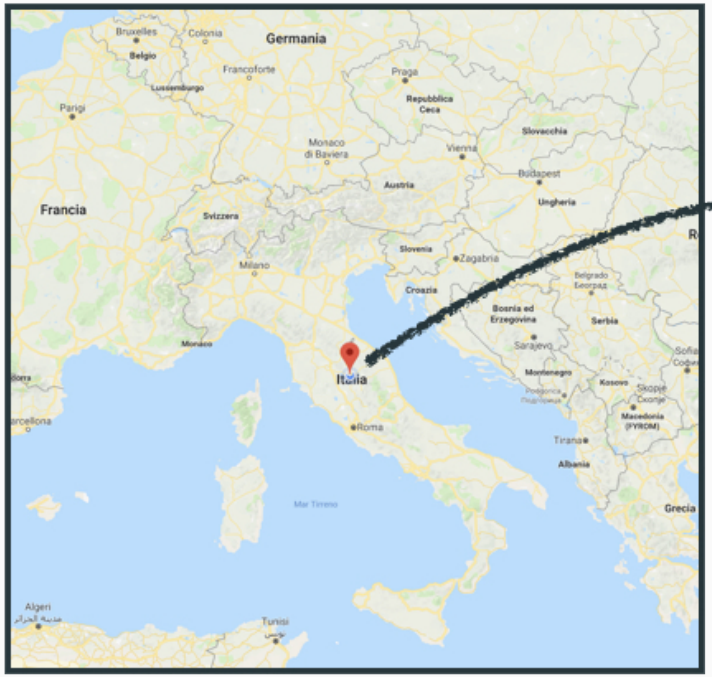
- **Grow!**

  Support to the local economy

- **Take care!**

  Of the enviroment, the territory and its history

Where do I come from?

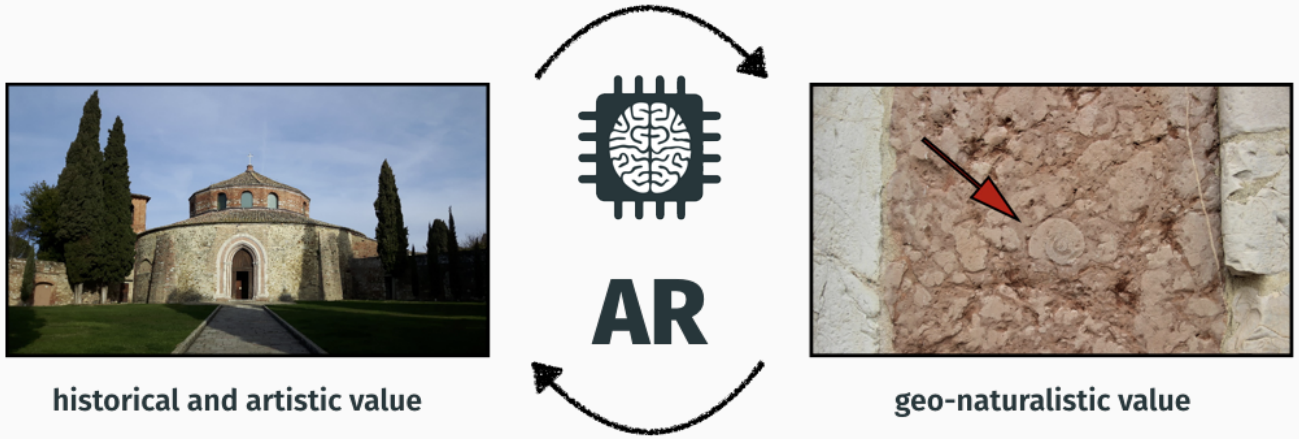


Italy

Perugia

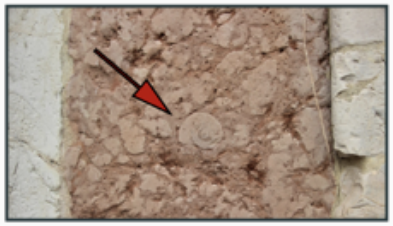
HUSH - Hiking in Urban Scientific Heritage

HUSH is a cross-platform mobile application that guides the user through points of scientific interest in urban areas.



Some examples of scientific content...

- **Geological**
  - **Paleontological**
  - **Hydrogeological**
  - **Lithological**
- **Naturalistic**
  - **Flora**
  - **Fauna**



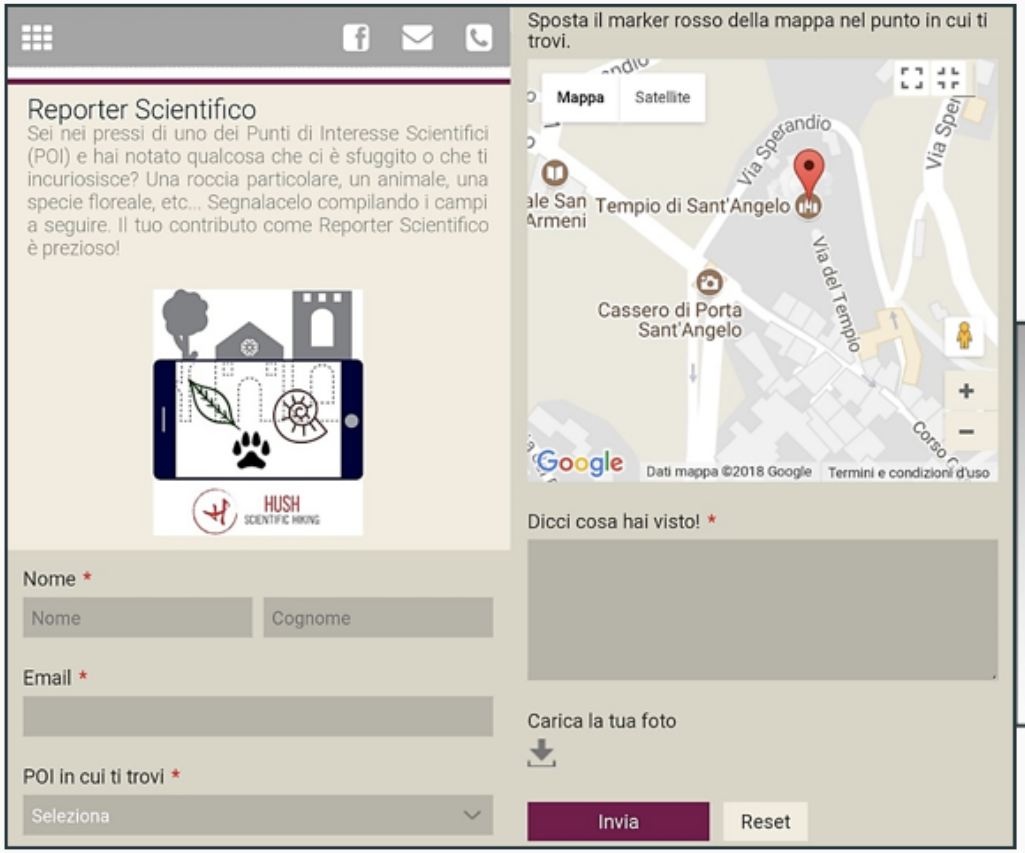
Scientific Hiking

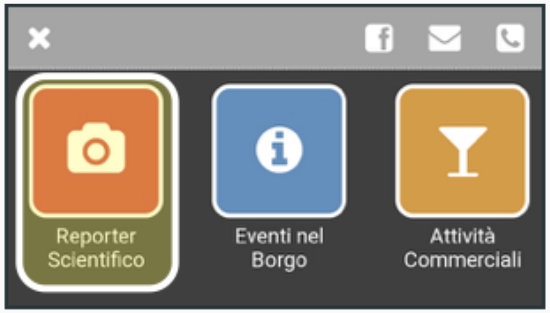
- Localization of Points of Scientific Interest
- Navigation to the Point location
- Indication of the element to be framed

- By framing the element it is possibile to access the Augmented Reality content
- A surfing menu allows you to explore the scientific content

Scientific reporter

Within the app the information flow is not unidirectional.





USER INVOLVED IN THE DEVELOPMENT OF SCIENTIFIC CONTENTS

Citizen Science

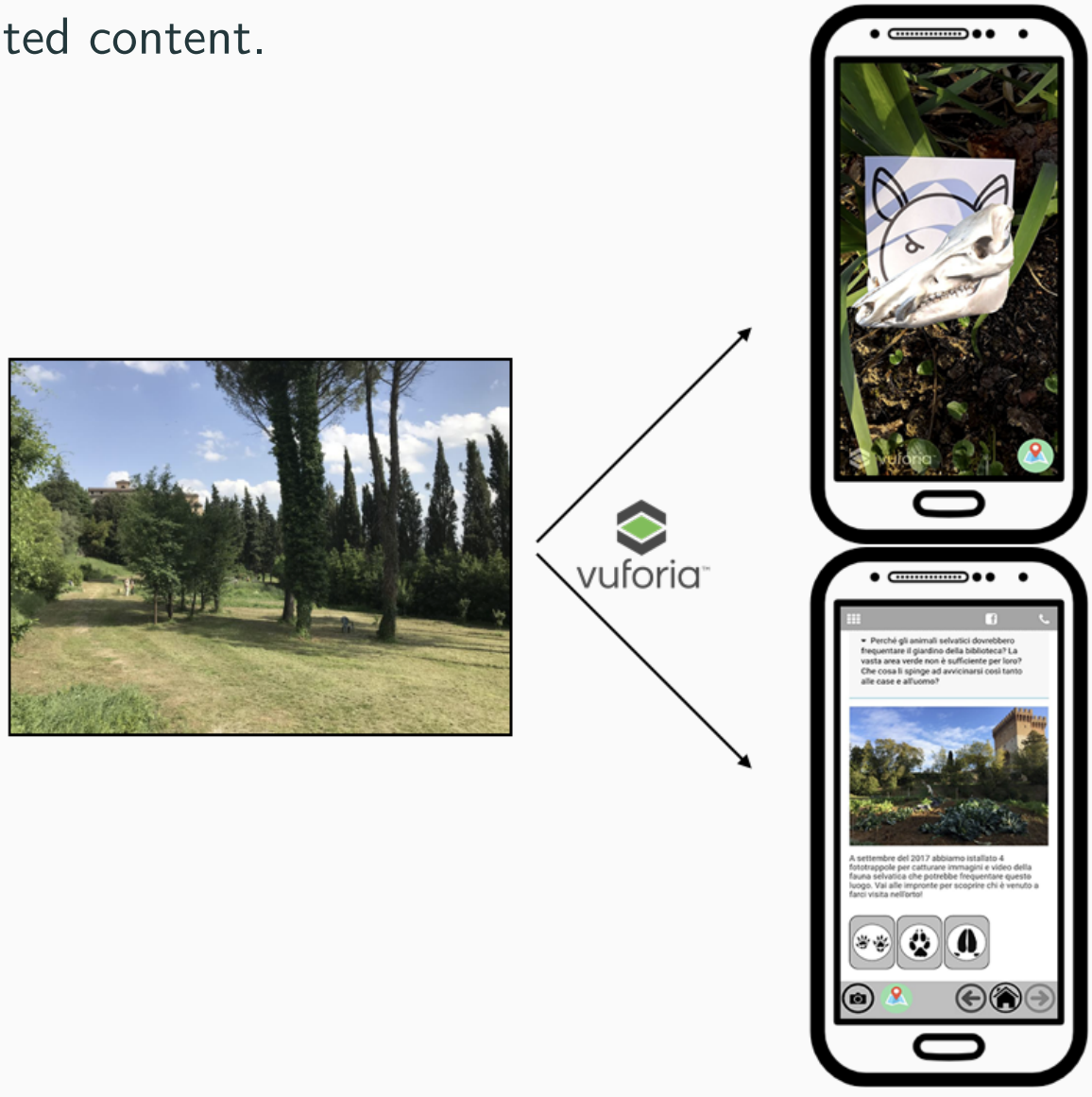
Application flow

The app flow is very simple and it is divided into three main parts:

unity

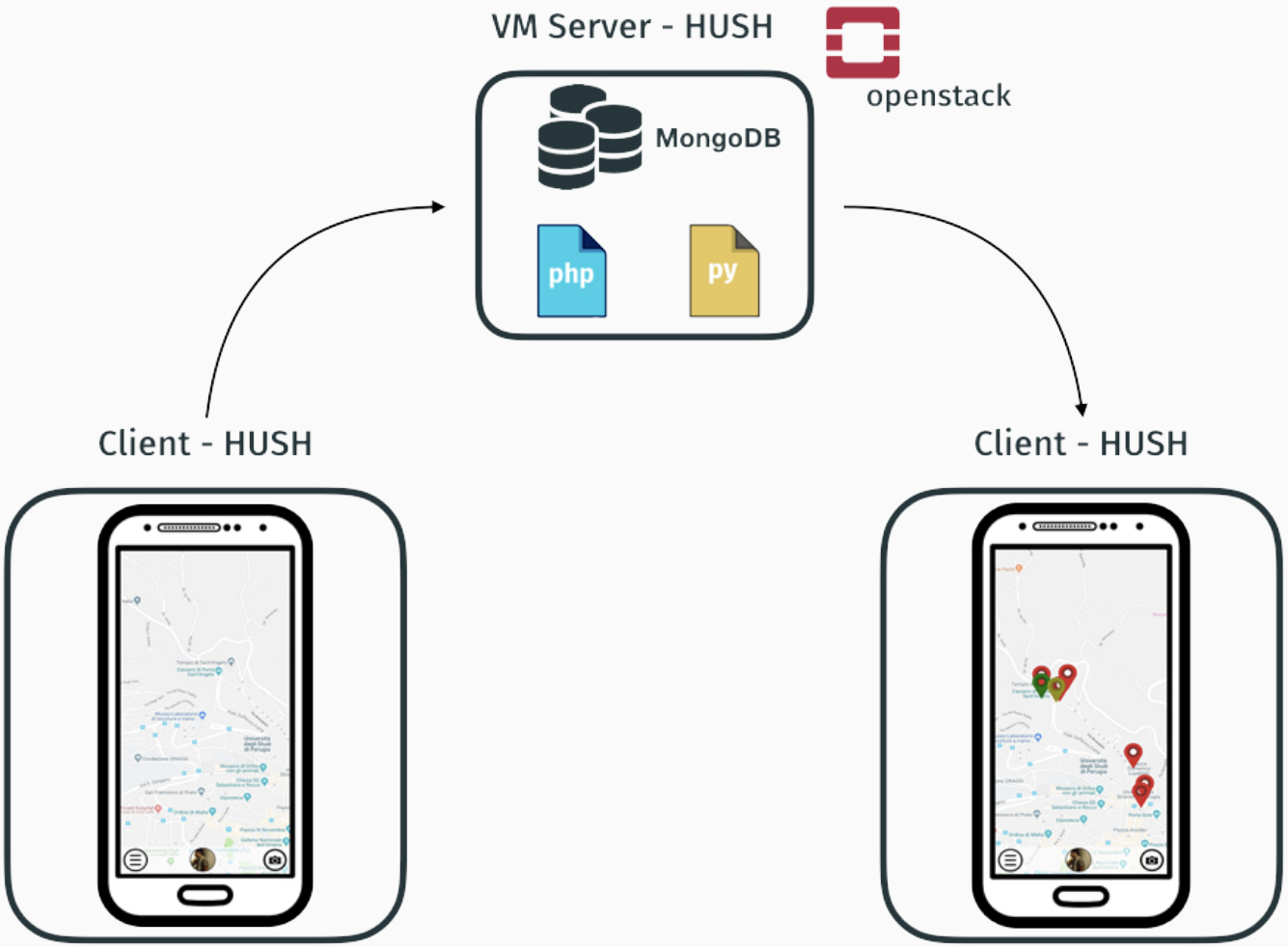
AR Mode

The implementation of augmented reality within the app is achieved with Vuforia, which enables recognition of target images and associated augmented content.



Maps section

The map shows the points of interest that the user can visit, which are downloaded in real time from the database.



Points of Interest 1/2

Points of interest are divided into three macro-categories:

- **Geological**
- **Naturalistic**
- **Commercial**

Every macro-category has sub-categories and a logical or numerical value is assigned to each of them.

Type of scientific content							
Geological				Naturalistic		Commercial	
Paleontological	Lithological	Geomorphological	Hydrogeological	Flora	Fauna	Commercial	Public

Type of place			
Artistic	Spiritual	Naturalistic-fun	Commercial

Type of multimedia content			
Text	Image	Video	Augmented Reality

Points of Interest 2/2

Example: Etruscan Arch

- **logical**: true/false
- **numerical**: not all **0** → a lot **3**

Geological				Naturalistic		Commercial	
Paleontological	Lithological	Geomorphological	Hydrogeological	Flora	Fauna	Commercial	Public
0	3	2	2	0	0	0	0
B,C	B,C	B,C	B,C	A	A	D	F

Artistic	Spiritual	Naturalistic-fun	Commercial
3	0	0	0
I	H	A	None

Text	Image	Video	Augmented-Reality
T	T	F	F
None	None	None	L

Personalize user experience

Personalize user experience

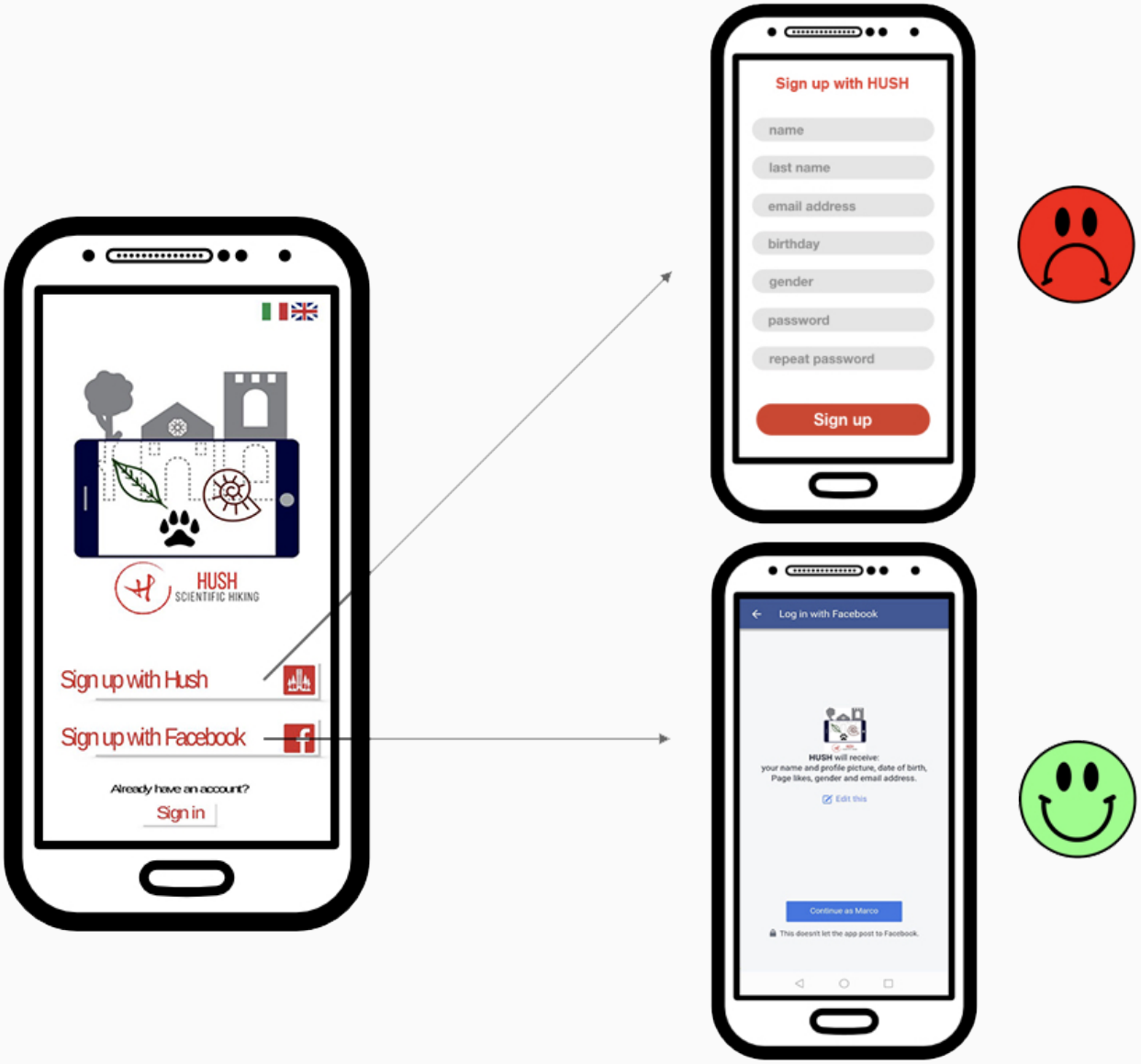
GOAL

Optimize and personalize user experience, improving the quality of the service and the use of the content.

Only show the user Points of Interest with contents related to likes and activity on their social media profile.

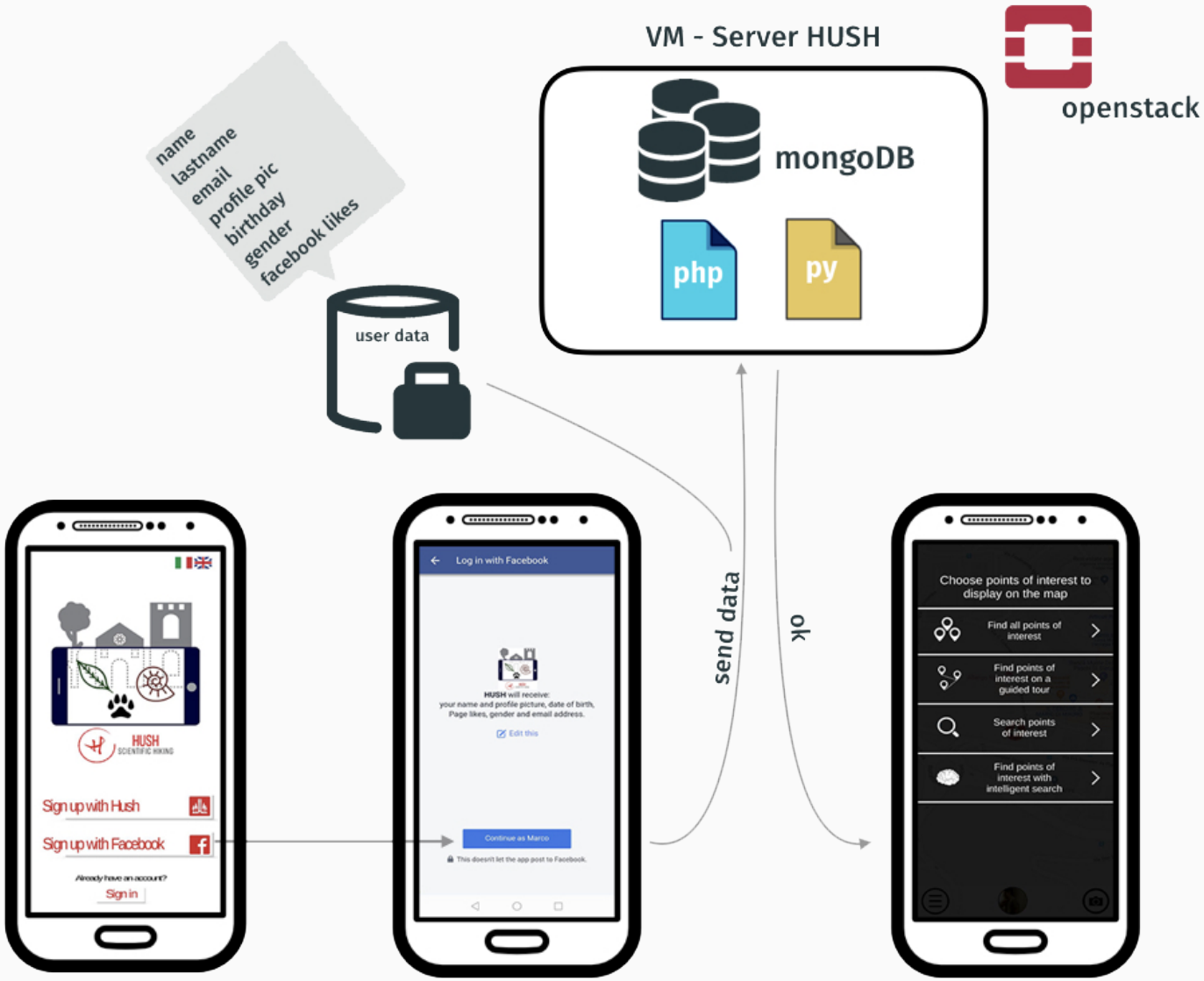
User sign up

From a user perspective...



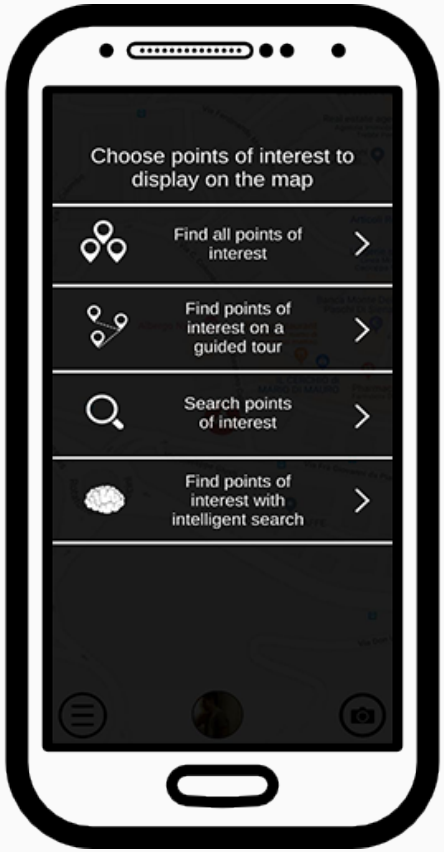
Facebook sign up

What happens when a user signs up with Facebook?



Choose points of interest

There are several ways for the users to choose which points of interest they want to visit:

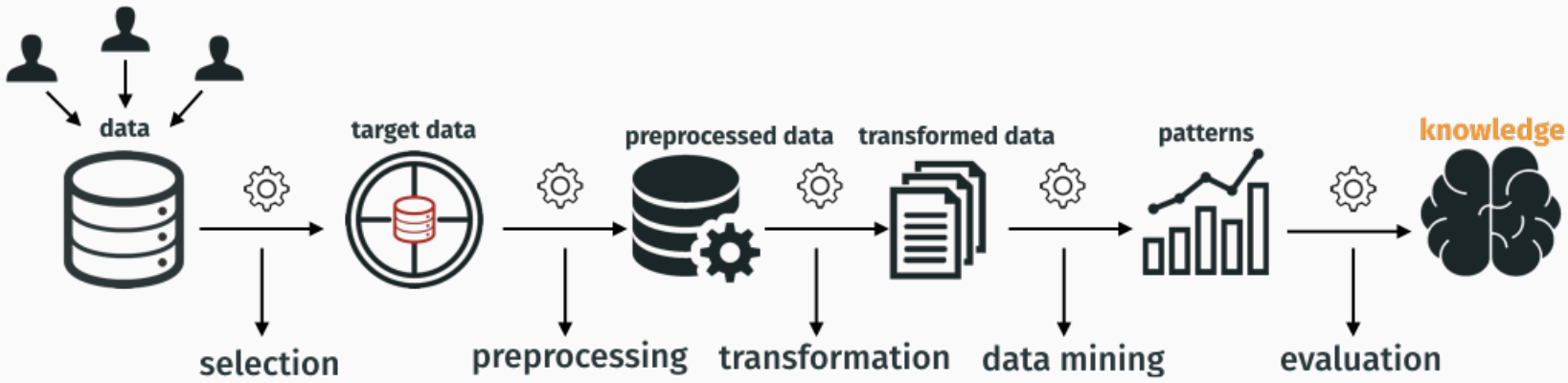


- Display all points of interest;
- Display points of interest along predefined paths;
- Display points of interest with the use of search keys;
- **Display points of interest with the intelligent search**.

Intelligent search

KDD - Knowledge Discovery in Databases

The term knowledge discovery in databases indicates the entire process of searching for new knowledge from the data.



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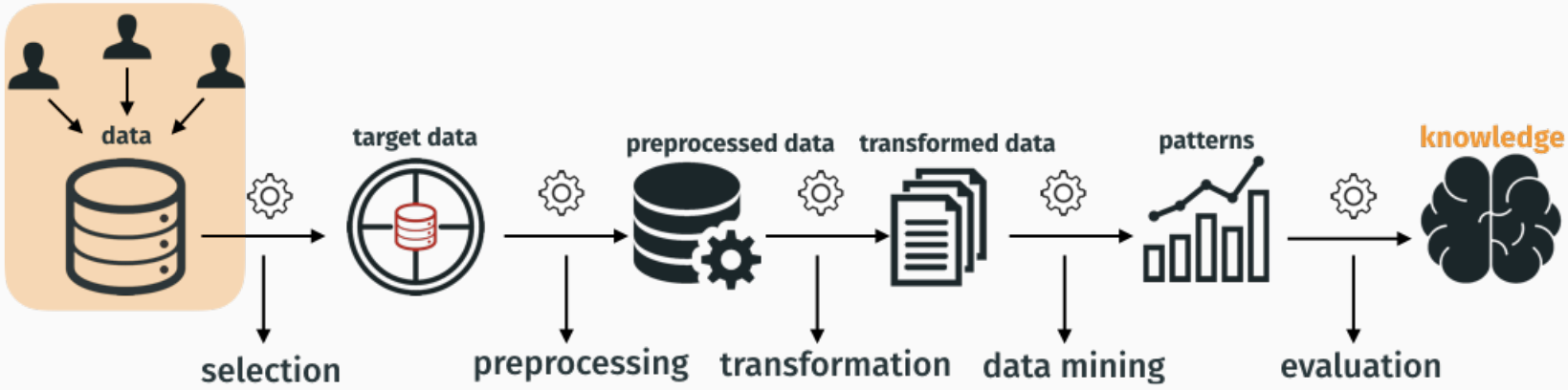

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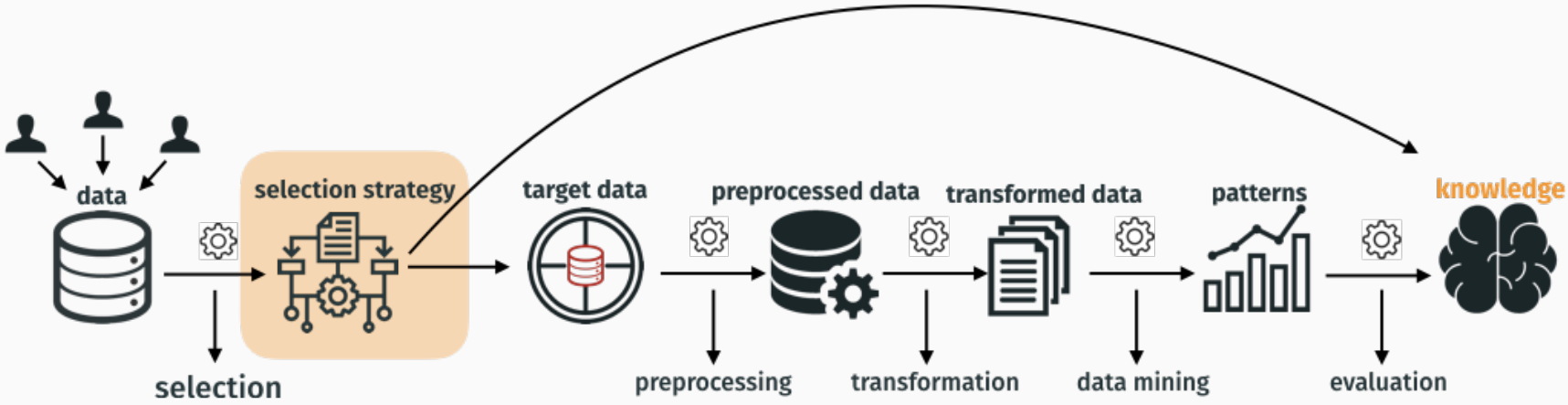
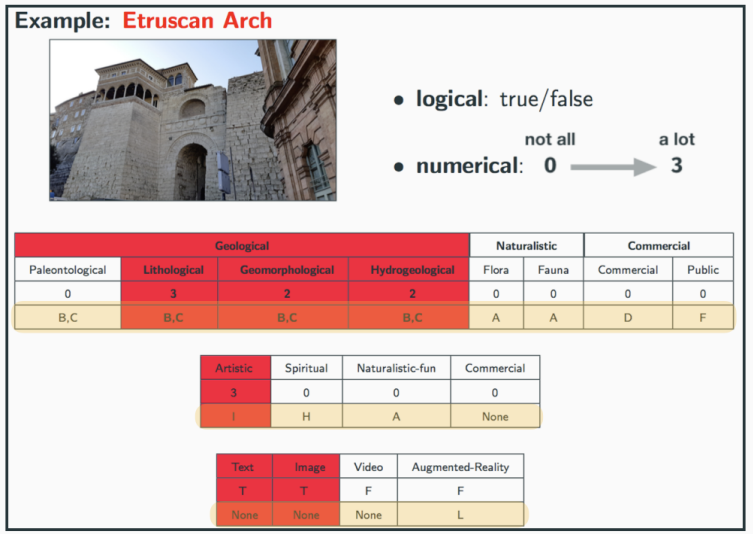


Facebook categories

Facebook pages are organized in more than 1500 categories. We filtered them by only keeping those which are relevant for our classification purposes. A label was assigned according to the type of content.

ID	FB Category	0:remove,1:keep	Label
1	Water Park	1	L
2	Aquarium	1	A
3	Art Museum	1	I
4	Geological Service	1	B
5	Science	1	C

- **A**: Naturalistic;
- **B**: Geographic;
- **C**: Scientific;
- **D**: Commercial (objects, souvenir, accessories);
- **E**: Commercial (food);
- **F**: Public (restoration);
- **G**: Public (entertainment);
- **H**: Spiritual;
- **I**: Artistic, historical, cultural;
- **L**: Playful/computer based.

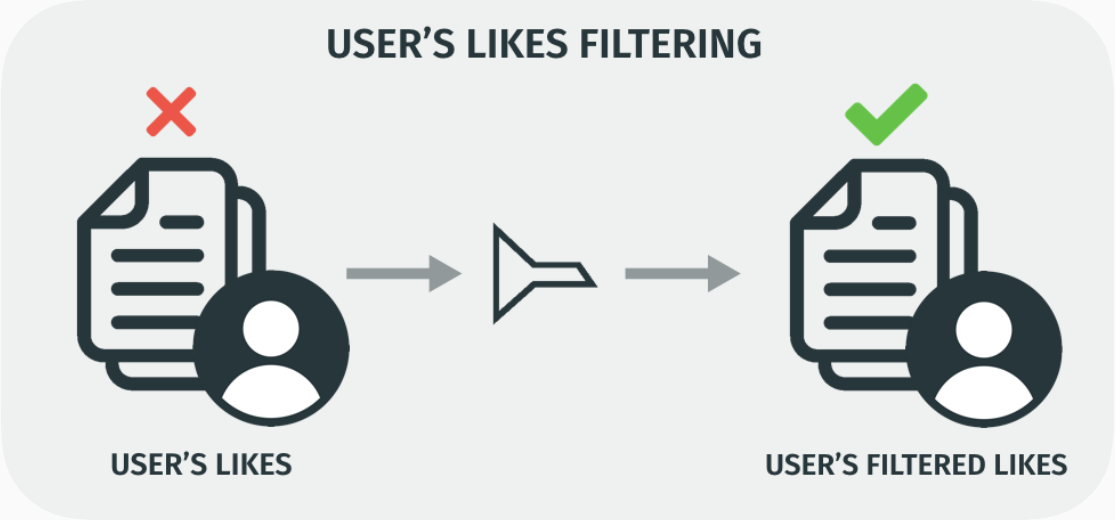


Selection strategy points of interest

N = number of points of interest defined by the user to be included in the custom path.

1. **STEP 1**: the intelligent selection of PoIs takes into account the labels of FB preferences which are linked to geological and naturalistic PoIs (A,B,C,H,I,L);
2. **STEP 2**: Once the PoIs are identified, commercial PoIs are suggested according to the following criteria:
   - Geographical distance from Geological and Naturalistic PoI;
   - Labels of FB preferences, which can be associated to the commercial PoIs.

Selection procedure for Geological and Naturalistic PoI



Case A

After filtering, none of the user likes falls within the labels A,B,C,H,I,L;

Error message: we are not currently able to suggest you a customized path! Try to select PoIs with some keys!

Selection procedure for Geological and Naturalistic PoI

Case B

After the filtering, at least one like is within the labels A,B,C,H,I,L;

Real case example

The user has 12 likes to pages relevant to categorization.

Labels	Count	Percent.
A	2	16.66%
B	1	8.33%
D	0	0%
E	0	0%
F	5	41.66%
G	0	0%
H	0	0%
I	3	25.0%
L	1	8.33%

Labels	Count	Percent.
A	2	28.57%
B	1	14.28%
H	0	0%
I	3	42.85%
L	1	14.28%

Selection procedure for Geological and Naturalistic PoIs

Case B

- **n** = number of points of interest
- α = PoI category value / sum of category value

$$\textbf{Score}_{\textbf{PoI}} = \sum_{i=0}^{n} \sum_{j=0}^{4} P_{\text{j}} * \alpha_{\text{j}}$$

- $i = 0...n$ index of PoIs;
- $j = 0...4$ index of labels;
- P = percentage preferences.

Algorithm result: every PoI will have a score that depends on the user preferences. The first N PoIs will be selected and shown on the map.

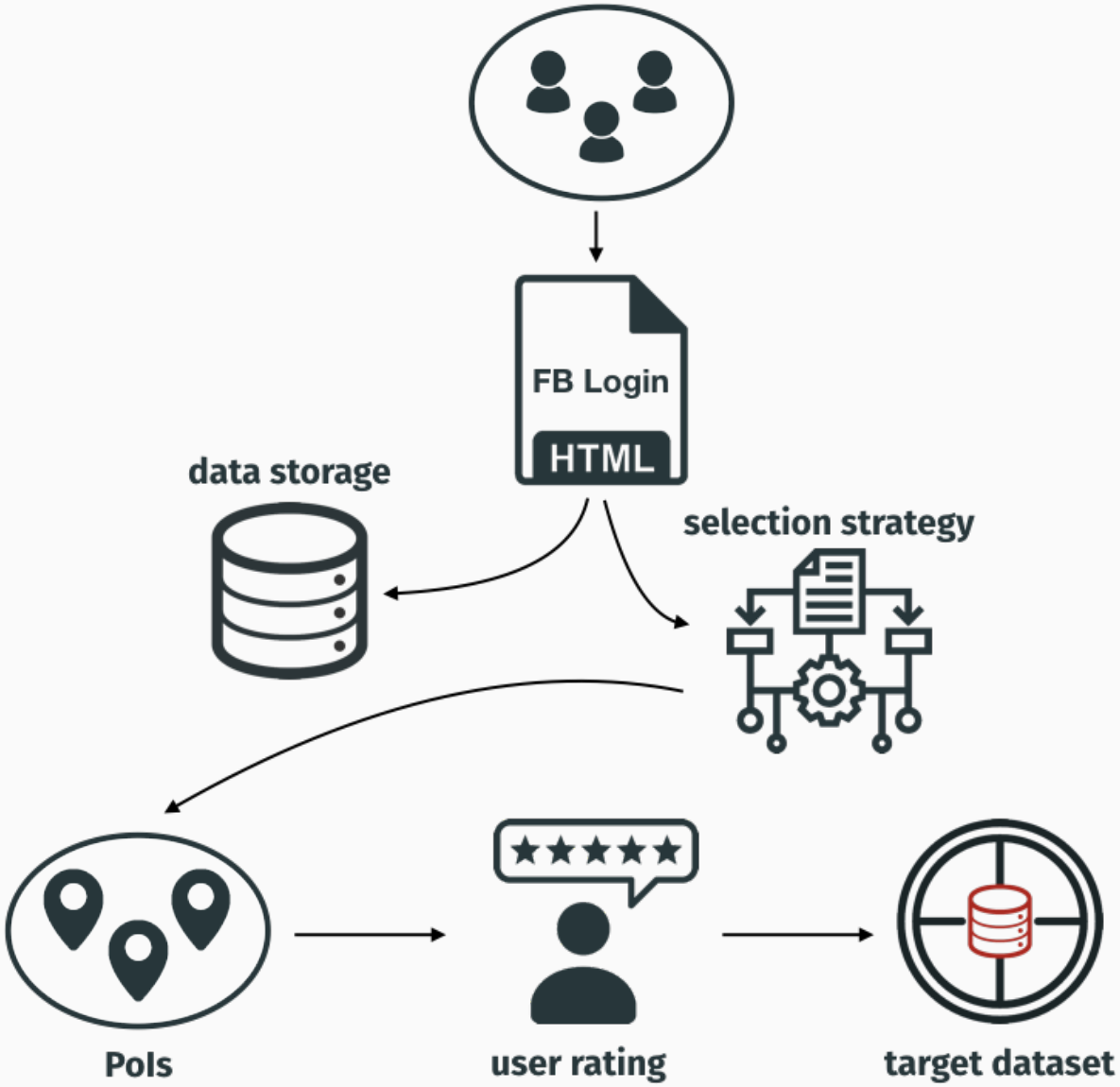
Real case example

most favourite

least favourite

PoI	
Id	**Score**
5	35.7
13	32.1
...	...

Building of the target dataset



Conclusions

New model of tourism

- that uses innovative technologies;
- completely different from the current ones;
- exportable in any other urban context;

To spread the science

- with high quality content;
- in an entertaining way;
- to valorize the naturalistic cultural and scientific heritage in the city.

Thank you for your attention!