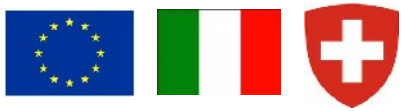


OSGeo's Global Conference for Open Source Geospatial Software

Nottingham 17 - 21 September 2013

Web-based Participatory GIS with data collection on the field: a prototype architecture

Maria Antonia Brovelli, Marco Minghini, Giorgio Zamboni

Politecnico di Milano, DICA - Geomatics Laboratory at Como Campus

POLITECNICO DI MILANO

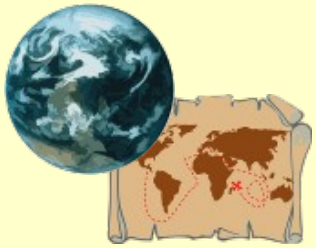
Geospatial Web

POLITECNICO DI MILANO

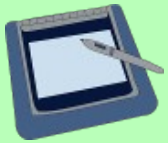
I CAMMINI DELLA REGINA
percorsi transfrontalieri legati alla Via Regina

Geospatial Web

Geospatial Web

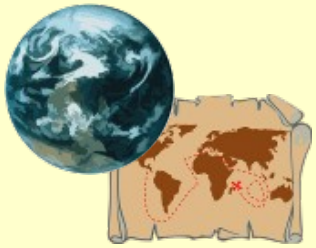


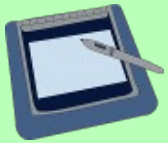
data



users

Geospatial Web



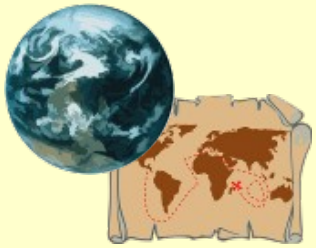


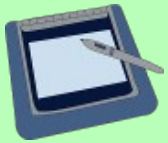
users

data

catalogues

Geospatial Web





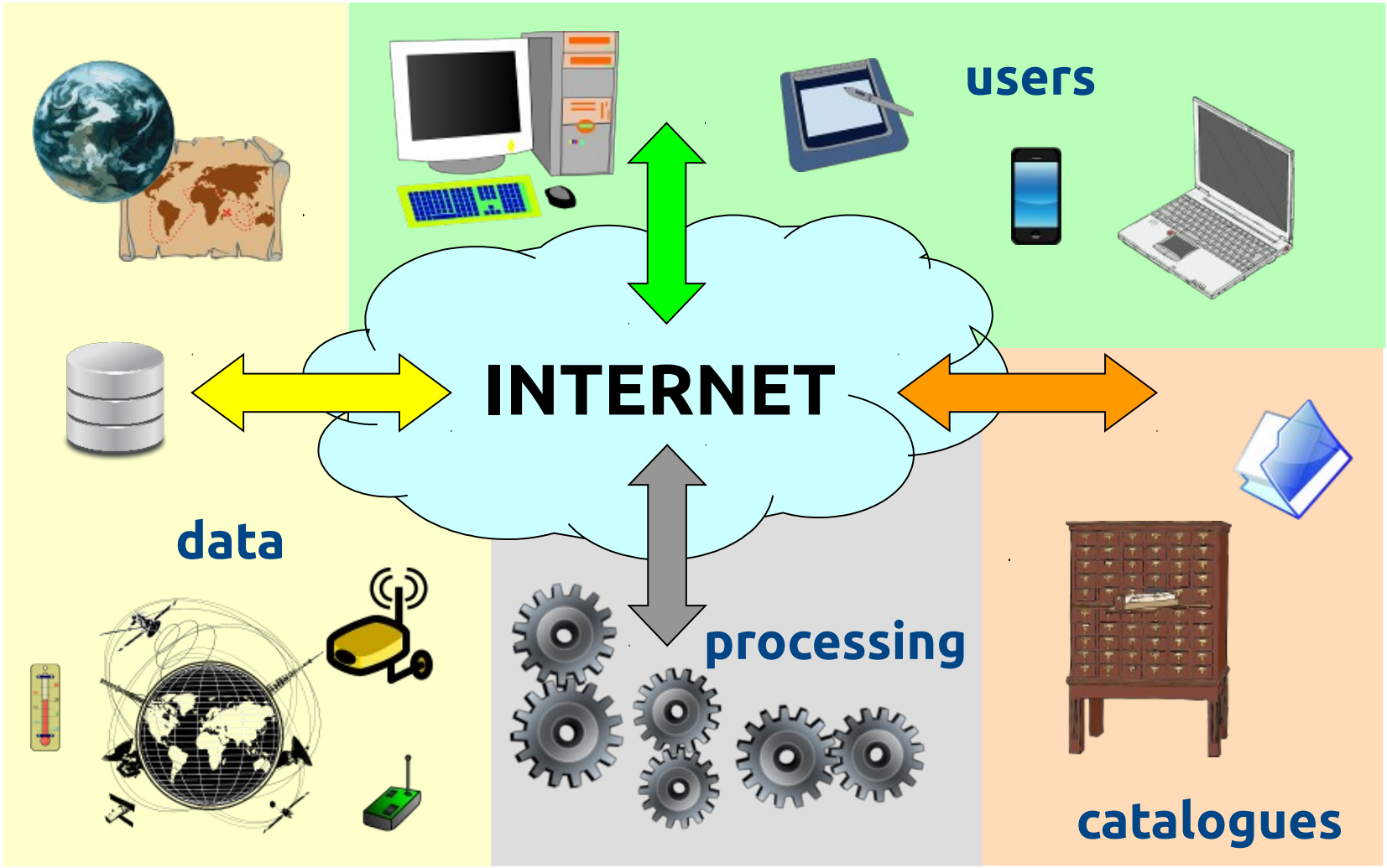
users

data

processing

catalogues

Geospatial Web



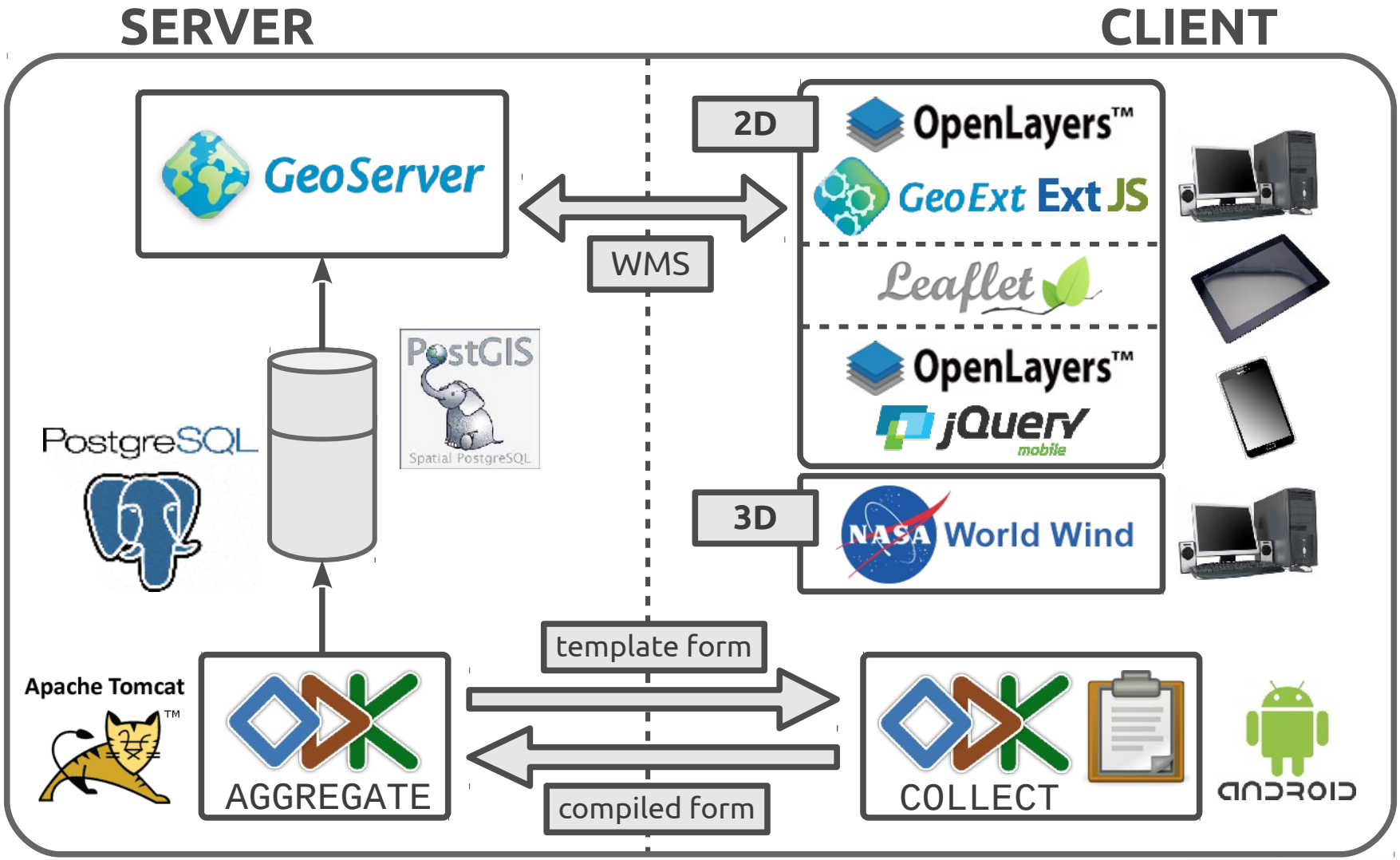
GeoWeb 2.0 and PGIS

- Web 2.0
  - online applications allowing rich user interaction
  - dynamic Web as opposed to static (1.0) Web
  - Web 2.0 in five keywords: sharing, participation, collaboration, user-generated information, virtual community
- GeoWeb 2.0 (Web Mapping 2.0)
  - interactive tools allowing user participation in spatial data management
  - neogeography: Web tools allow (non-expert) users to create their own maps
  - Volunteered Geographic Information (VGI): the idea of humans behaving like sensors able to register geospatial contents
- Proliferation of mobile devices equipped with sensors (GPS, camera, etc.)
  - users can easily perform real-time collection of georeferenced data
- Participatory GIS (PGIS)
  - GIS as a tool for promoting citizens' intervention in decision-making processes
  - Web-based applications allowing maps mash-ups, content upload and editing

PGIS - requirements

- Data description
  - information should be described with a standard language comprehensible to everyone (e.g. GML, KML, NetCDF, CityGML, WaterML)
- Data sharing
  - information should be made available through standard protocols in order to be widely accessed from different client applications (e.g. WMS, WFS, WCS)
- User administration
  - systems should manage multiple user profiles and their related privileges
- Mash-up
  - maps coming from different sources should be directly overlapped in order to automatically integrate multiple information referred to the same context
- Data editing
  - users should be able to manipulate (e.g. insert, update, delete) geographical features through standard common interfaces (such as WFS-T)

PGIS - an OS architecture



- Suite providing a set of tools for managing mobile data collection
  - http://opendatakit.org
  - free and open source under Apache2 license
  - developed from University of Washington – Department of Computer Science & Engineering
- Composed of 3 modules
  - form authoring tools:
    - ODK Build: graphical drag-and-drop tool for creating simple forms
    - XLSForm: form design via Excel spreadsheet
  - ODK Collect:
    - Android app for filling forms (which can contain multimedia and locations)
  - ODK Aggregate:
    - repository of the data sent by ODK Collect
    - can run in the cloud, on a virtual machine or on a private server (i.e. a Tomcat server backed with a PostgreSQL database)

Form creation

- ODK Build: graphical drag-and-drop tool for creating simple forms

Form creation XLSForm

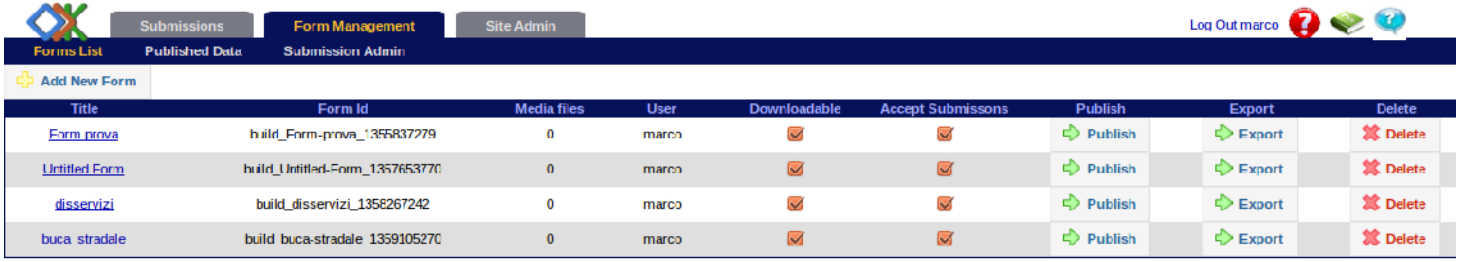
- XLSForm: form design via Excel spreadsheet

	A	B	C	D	E	
1	**list_name**	**name**	**label::Italiano**	**label::English**	**label::Español**	**tip**
2	tipologia_utente	tourist from Italy	turista italiano	tourist from Italy	turista italiano	
3	tipologia_utente	tourist from abroad	turista straniero	tourist from abroad	turista internacional	
4	tipologia_utente	Italian citizen	cittadino locale	Italian citizen	ciudadano italiano	
5						
6	tipologia_POI	point with panoramic view	punto panoramico	point with panoramic view	punto panorámico	
7	tipologia_POI	monument	monumento	monument	monumento	
8	tipologia_POI	historical/monumental building	edificio storico/monumentale	historical/monumental building	edificio histórico/monumental	
9	tipologia_POI	place of worship	luogo di culto	place of worship	lugar de culto	
10	tipologia_POI	place of artistic/cultural activities	sede di attività artistico/culturali	place of artistic/cultural activities	sede de actividad artística/cultural	
11	tipologia_POI	sports facility	impianto sportivo	sports facility	centro deportivo	
12	tipologia_POI	transport station	stazione di trasporto	transport station	estación de transporte	
13	tipologia_POI	event	evento	event	evento	
14	tipologia_POI_2	point of naturalistic/landscape int	punto di interesse naturalistico/pae	point of naturalistic/landscape interest	punto de interés natural/paisaji	point with pan
15	tipologia_POI_2	point of architectural interest	punto di interesse architettonico	point of architectural interest	punto de interés arquitectónico	point with pan
16	tipologia_POI_2	statue/sculpture	statua/scultura	statue/sculpture	estatua/escultura	monument
17	tipologia_POI_2	fountain	fontana	fountain	fuente	monument
18	tipologia_POI_2	historical monument	monumento storico	historical monument	monumento histórico	monument
19	tipologia_POI_2	castle	castello	castle	castillo	historical/mon
20	tipologia_POI_2	villa	villa	villa	villa	historical/mon
21	tipologia_POI_2	palace	palazzo	palace	edificio	historical/mon
22	tipologia_POI_2	lighthouse	faro	lighthouse	faro	historical/mon
23	tipologia_POI_2	bell tower	campanile	bell tower	campanario	historical/mon
24	tipologia_POI_2	tower	torre	tower	torre	historical/mon
25	tipologia_POI_2	church/basilica	chiesa/basilica	church/basilica	iglesia/basílica	place of worsh
26	tipologia_POI_2	baptistery	battistero	baptistery	baptisterio	place of worsh
27	tipologia_POI_2	convent	convento	convent	convento	place of worsh
28	tipologia_POI_2	cemetery	cimitero	cemetery	cementerio	place of worsh

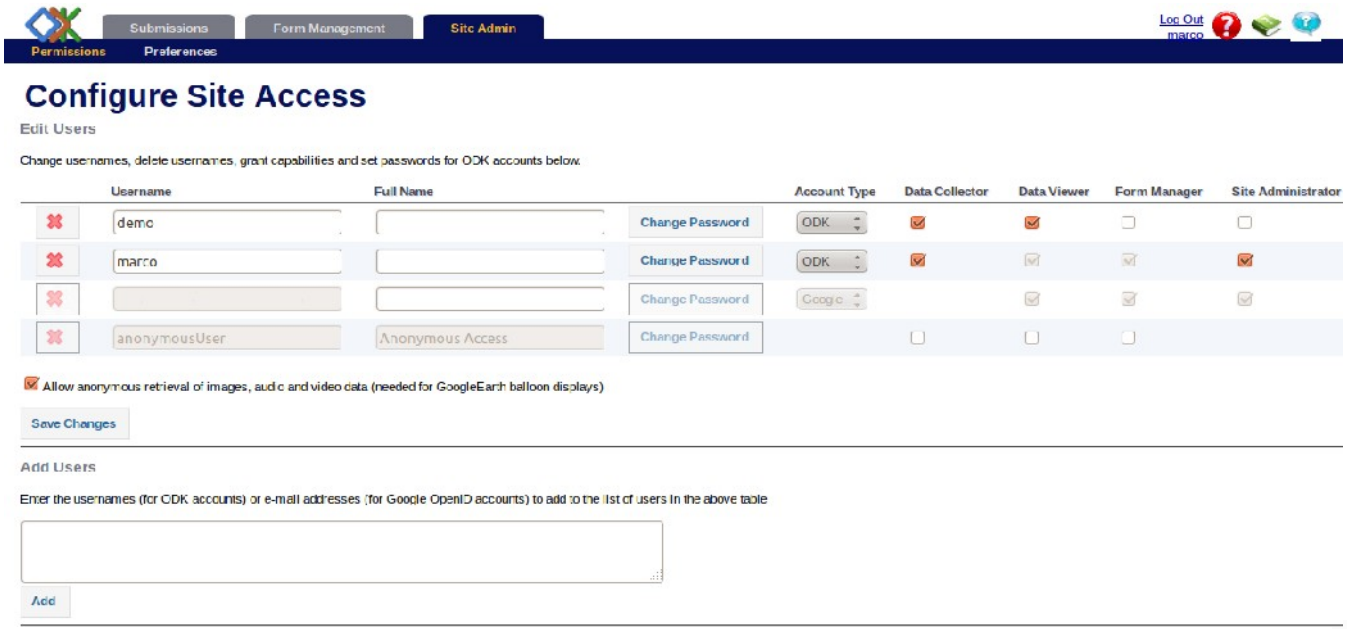
survey | choices | settings

Form management

- Form templates upload, option management and submitted forms export



- User administration and assignment of privileges



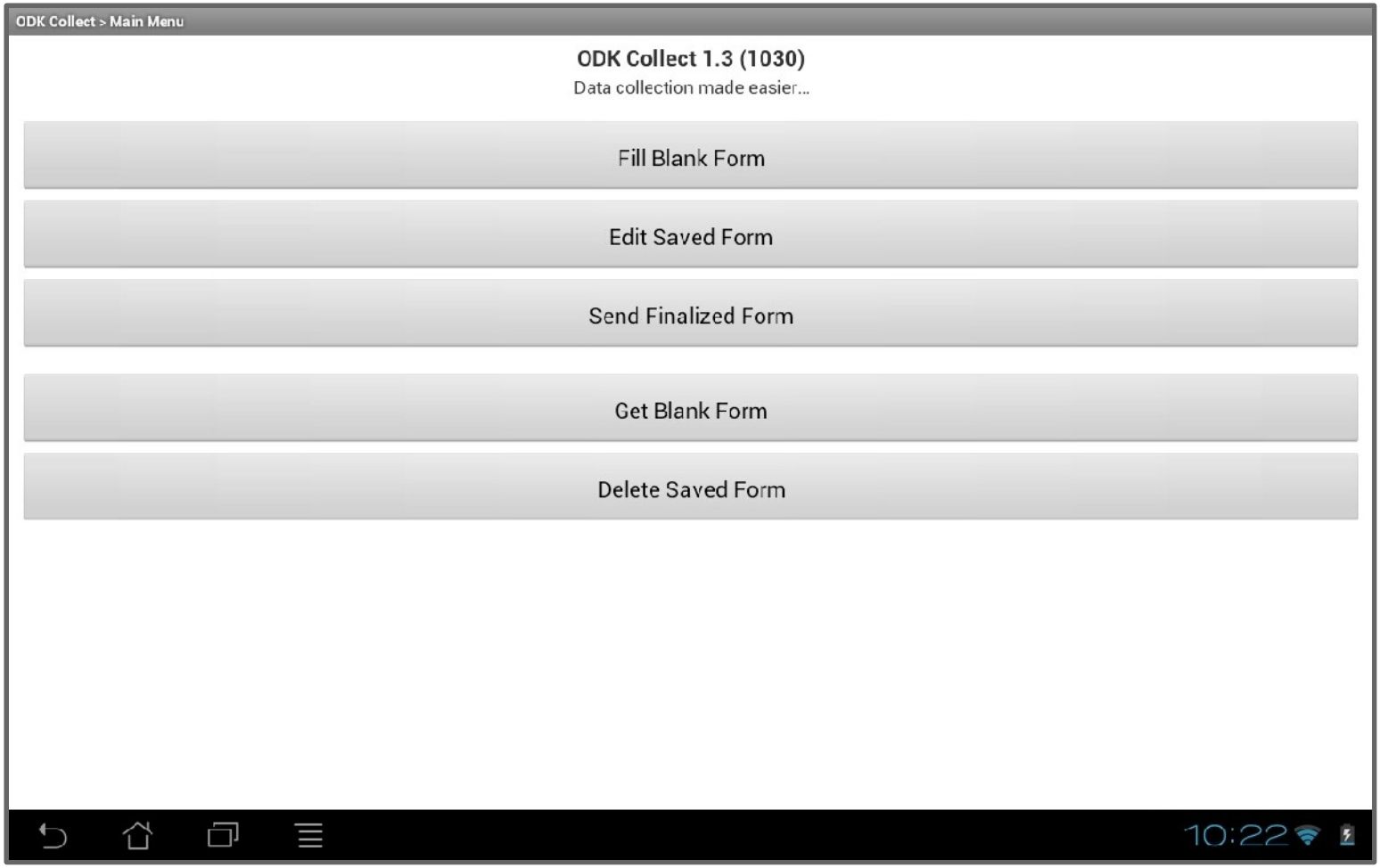
AGGREGATE

POLITECNICO DI MILANO

I CAMMINI DELLA REGINA
percorsi transfrontalieri legati alla Via Regina

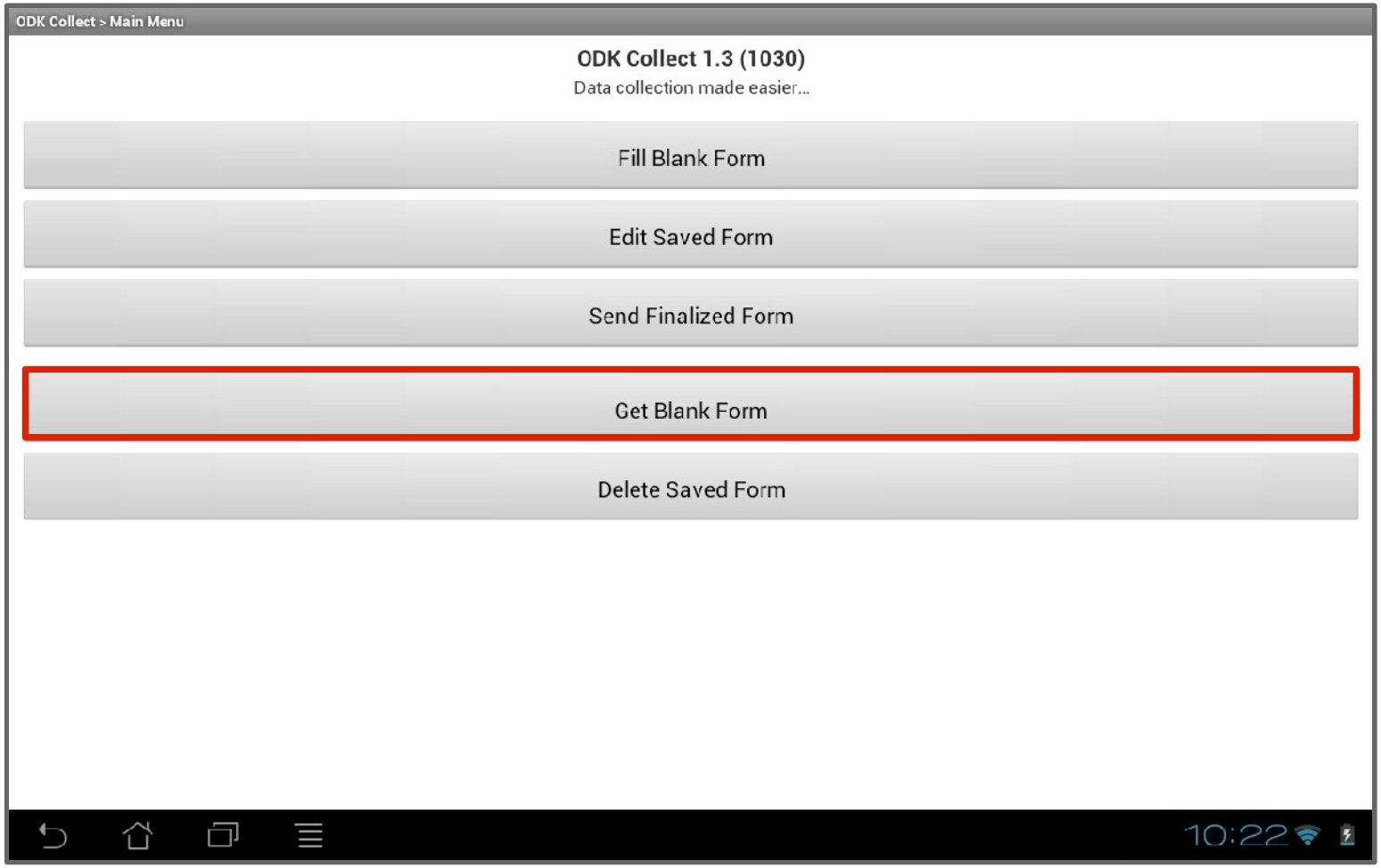
Data collection

- Application main menu



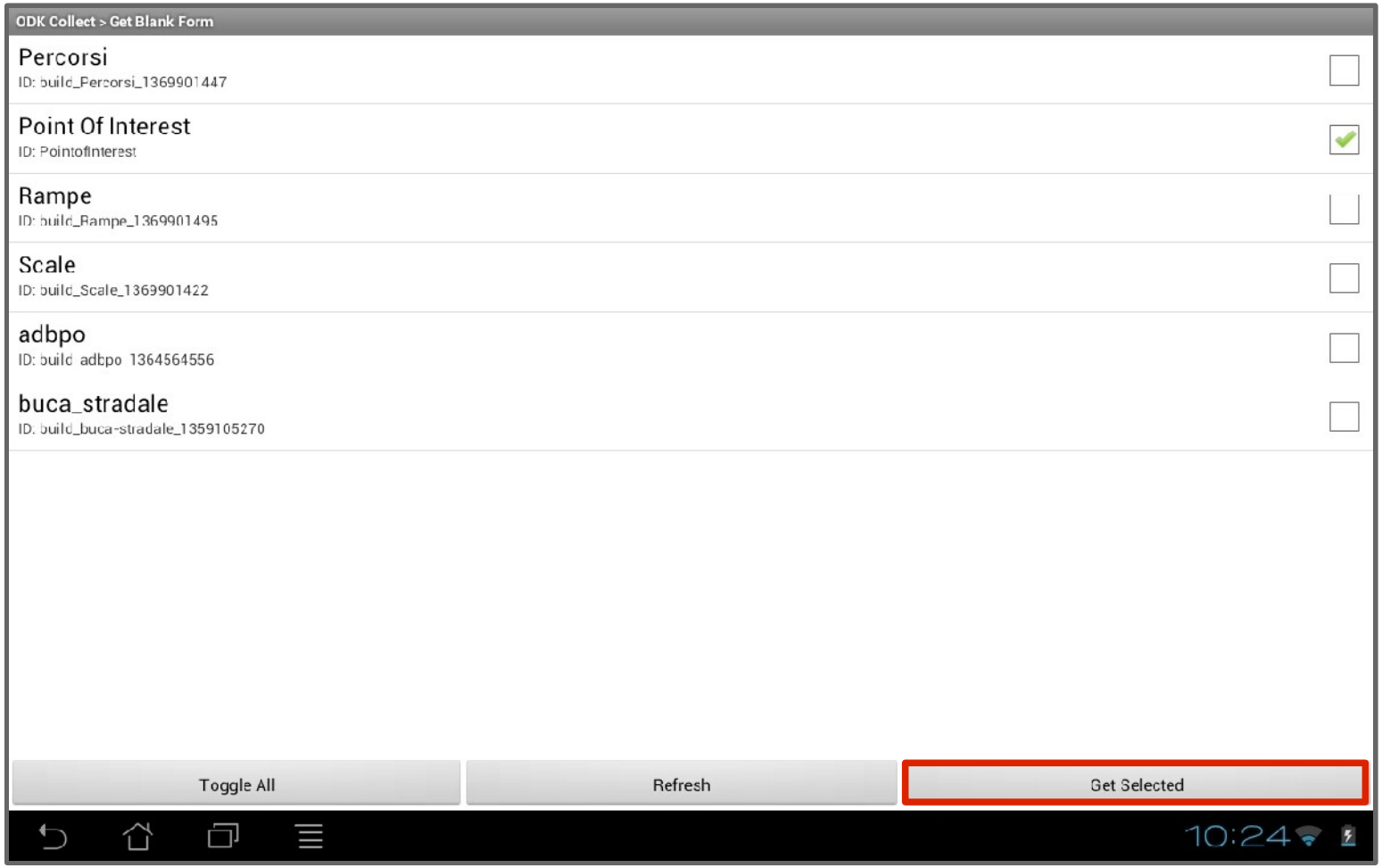
Data collection

- Application main menu



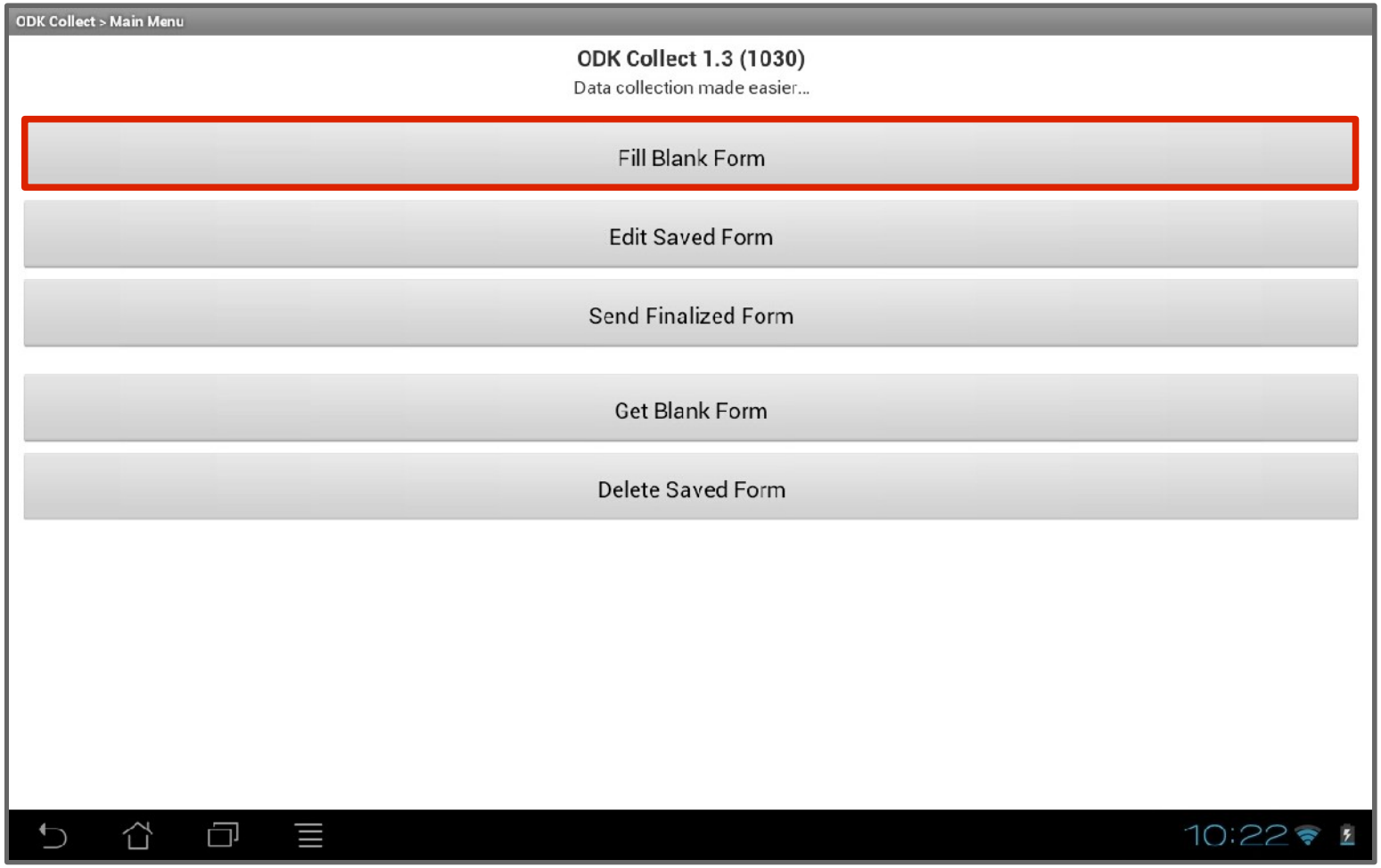
Data collection

- Download of form template



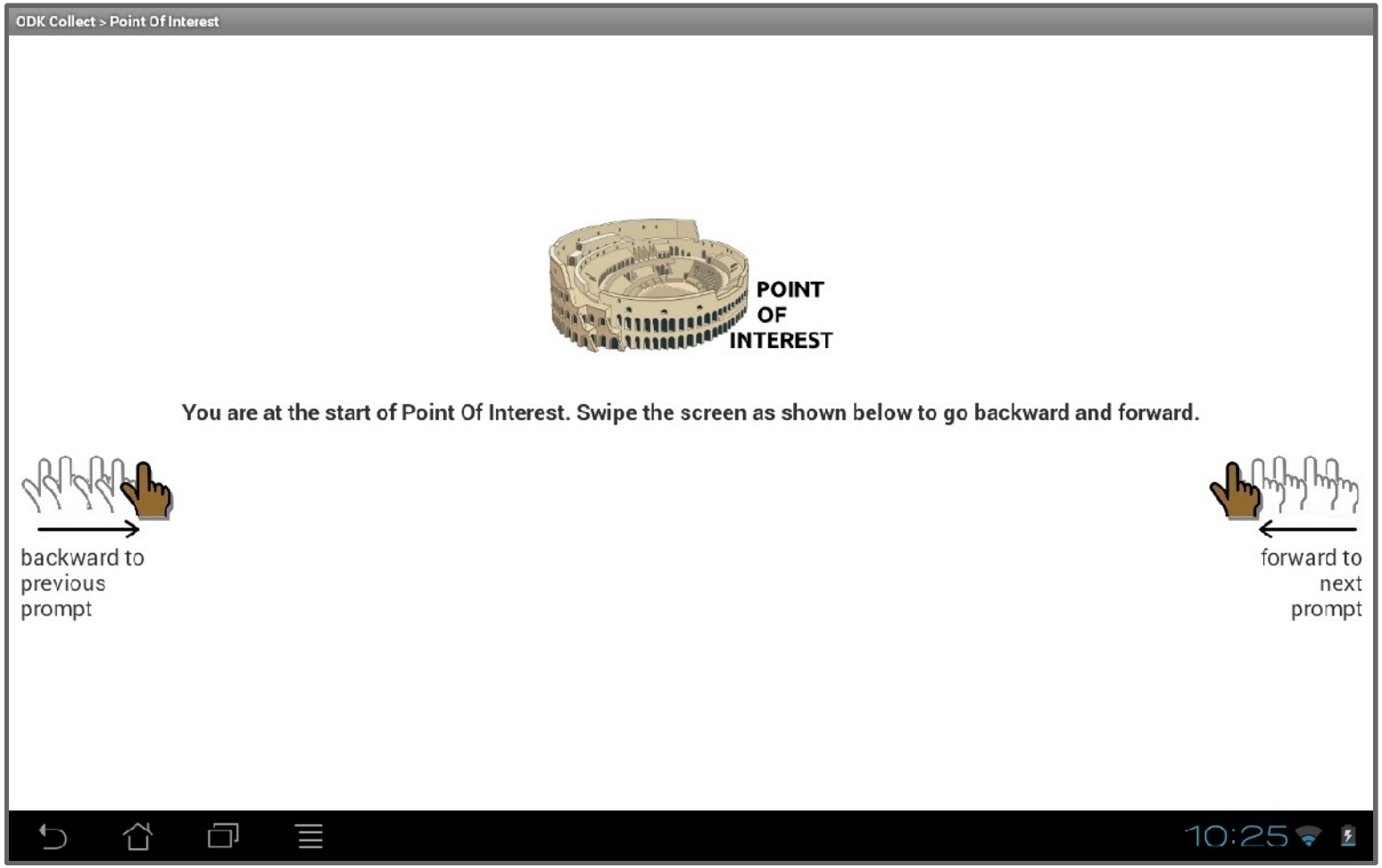
Data collection

- Application main menu



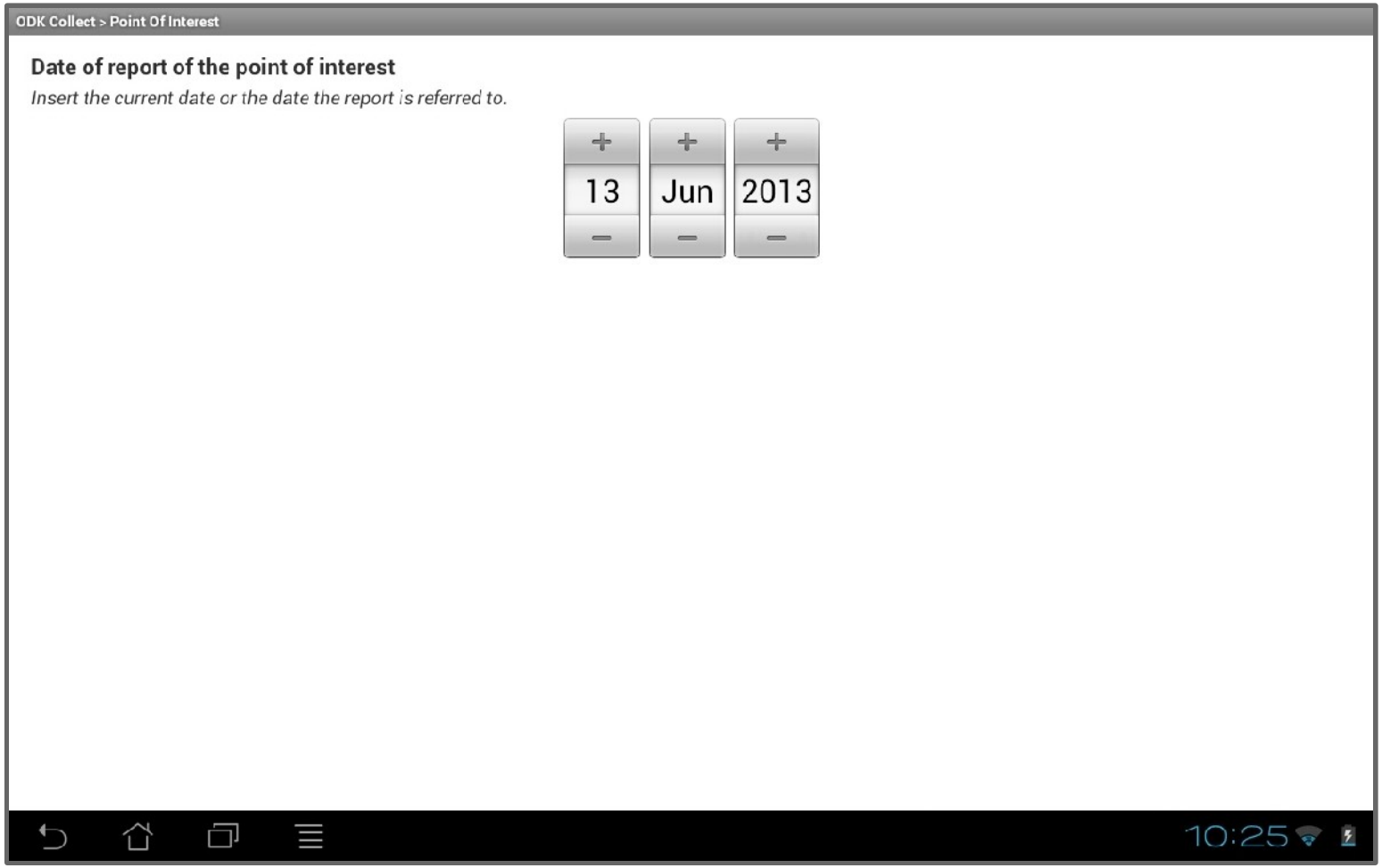
Data collection

- Guided form compilation



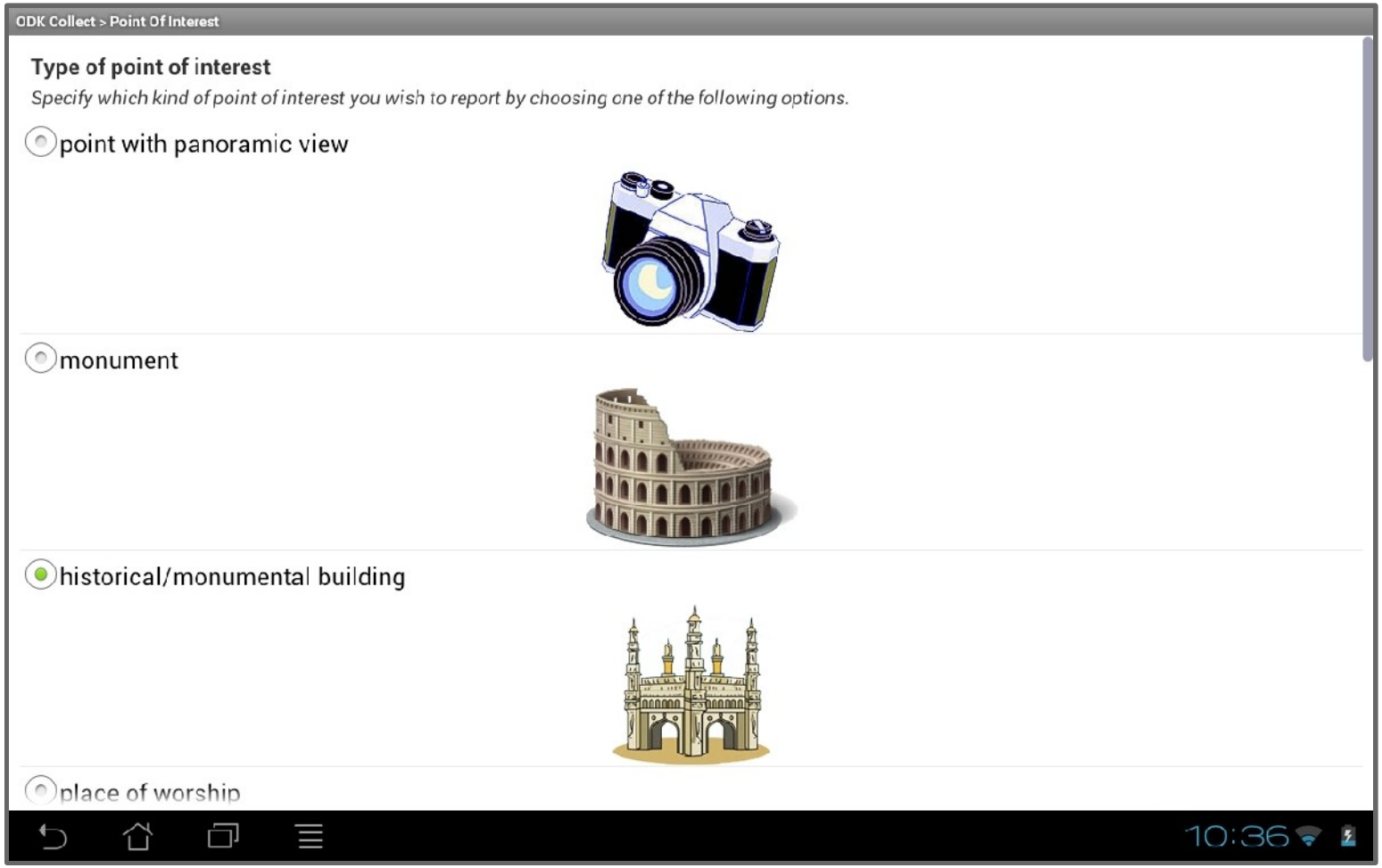
Data collection

- Guided form compilation



Data collection

- Guided form compilation



Data collection

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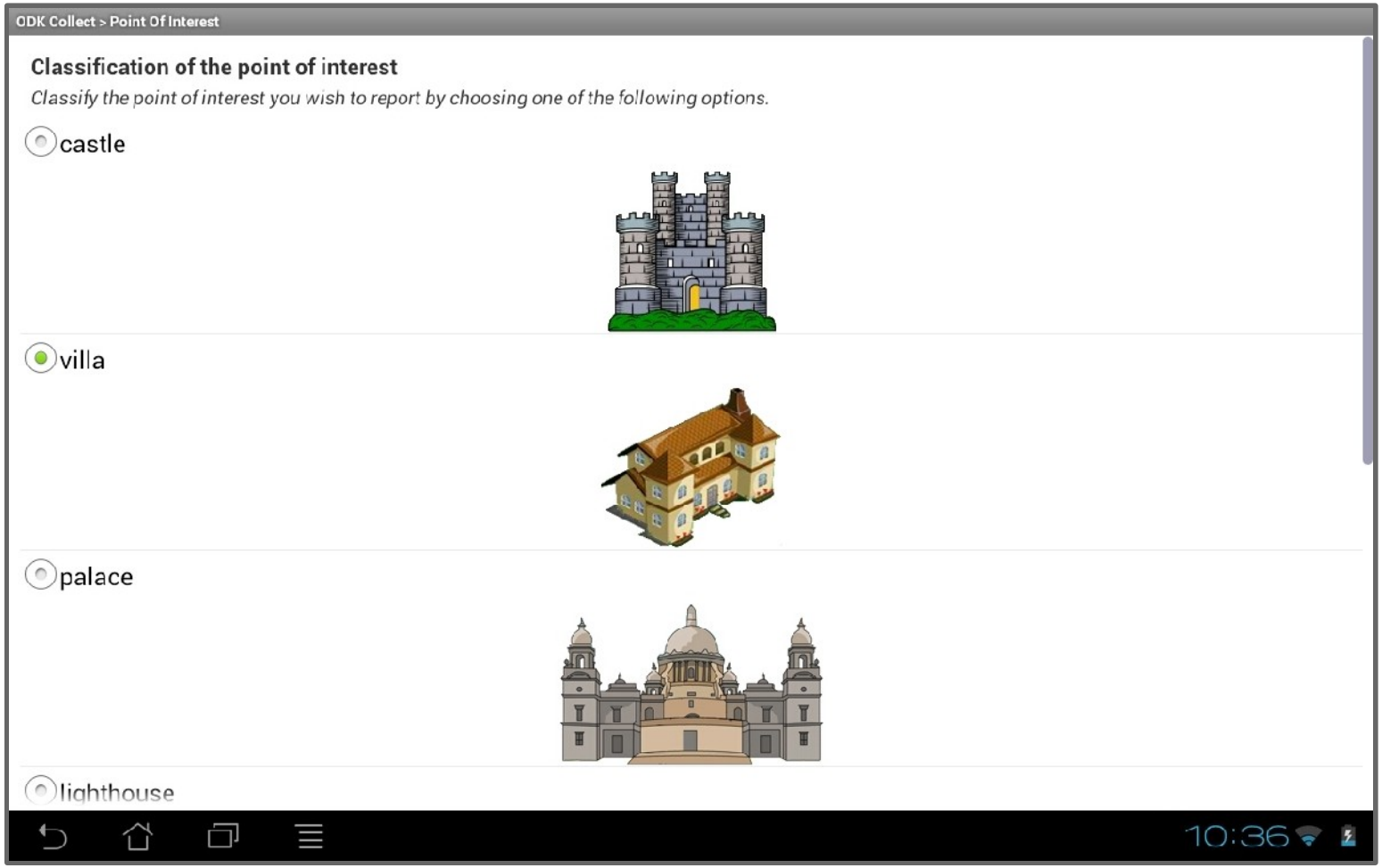
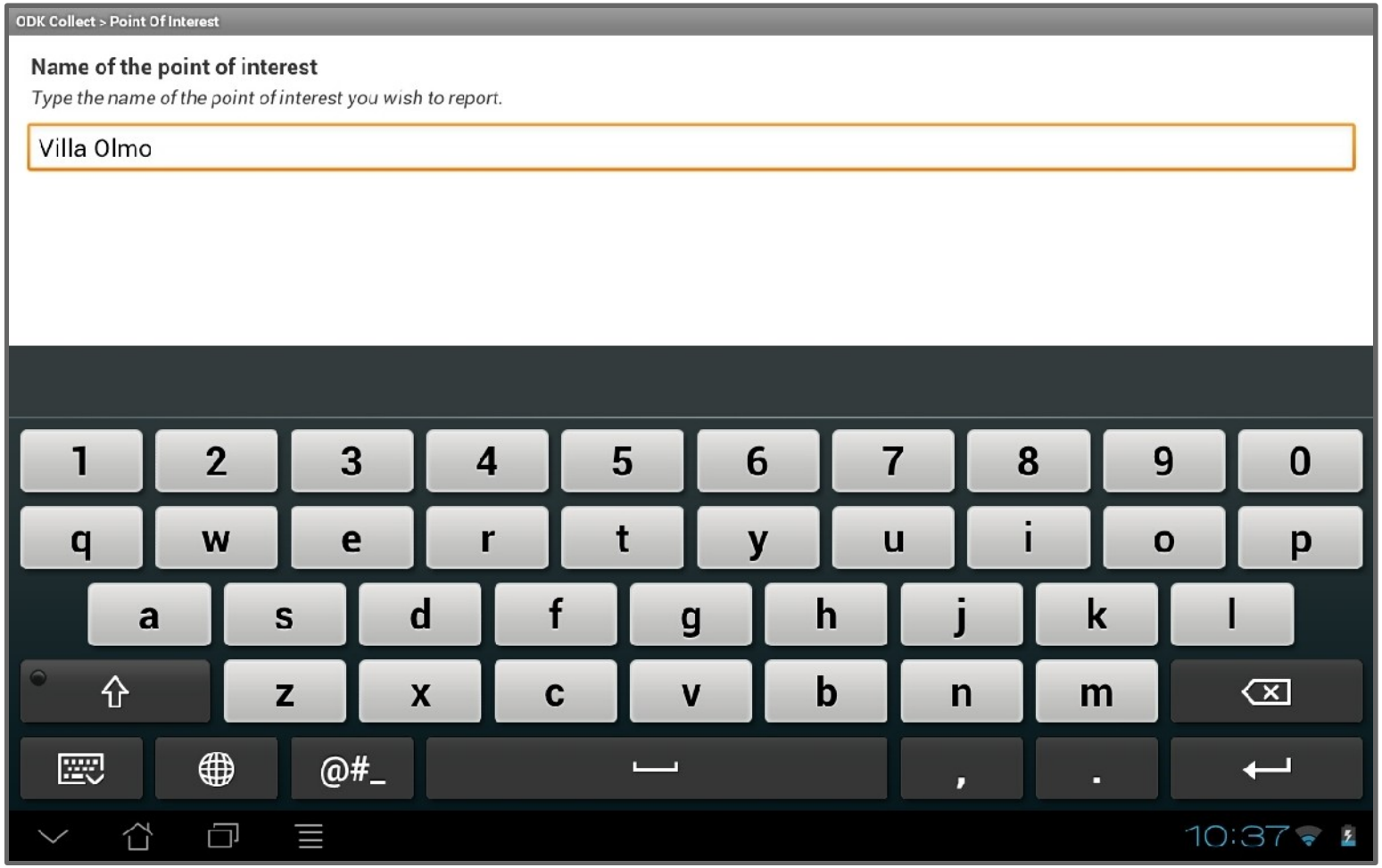


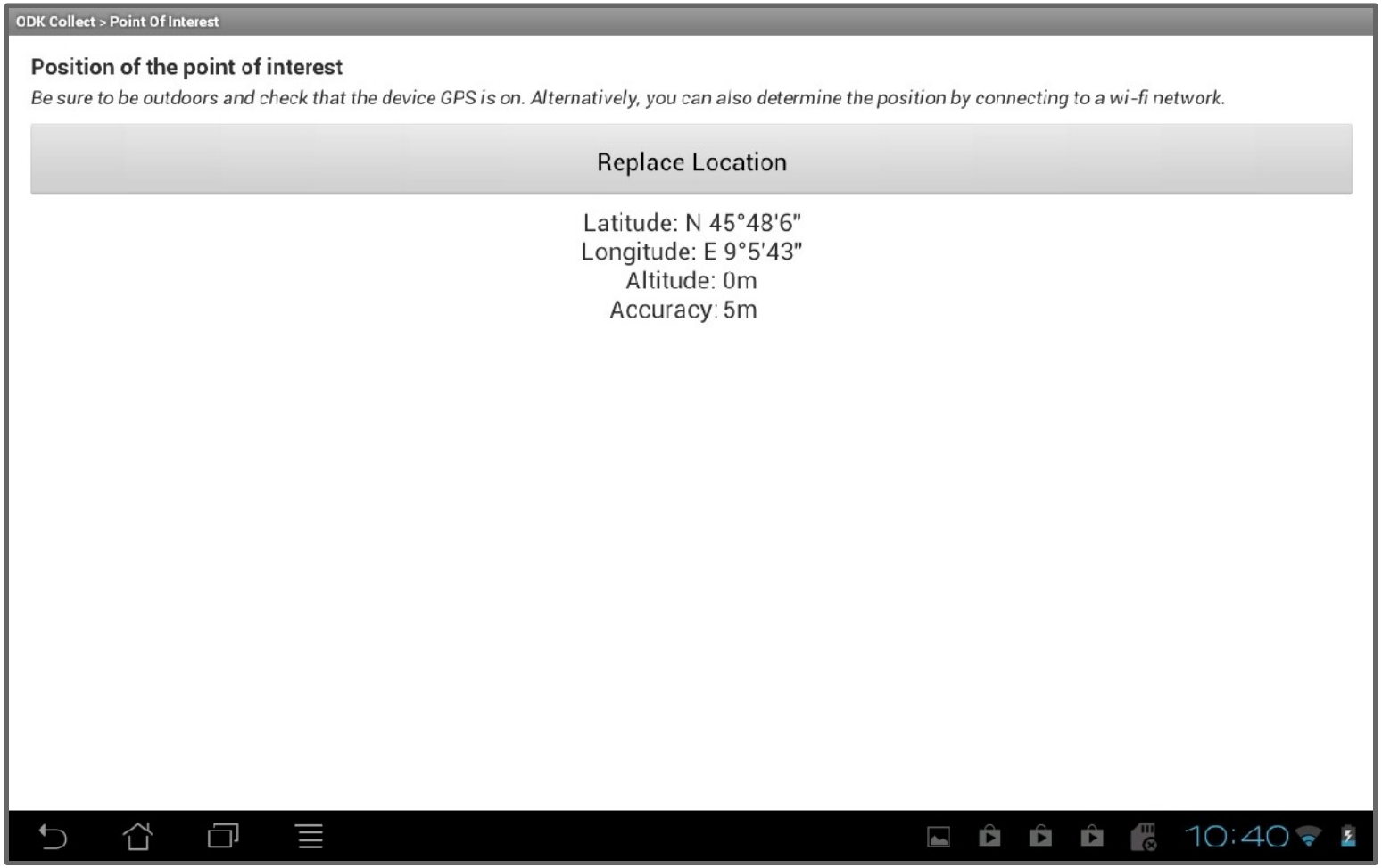
Data collection

- Guided form compilation



Data collection

- Guided form compilation



Data collection

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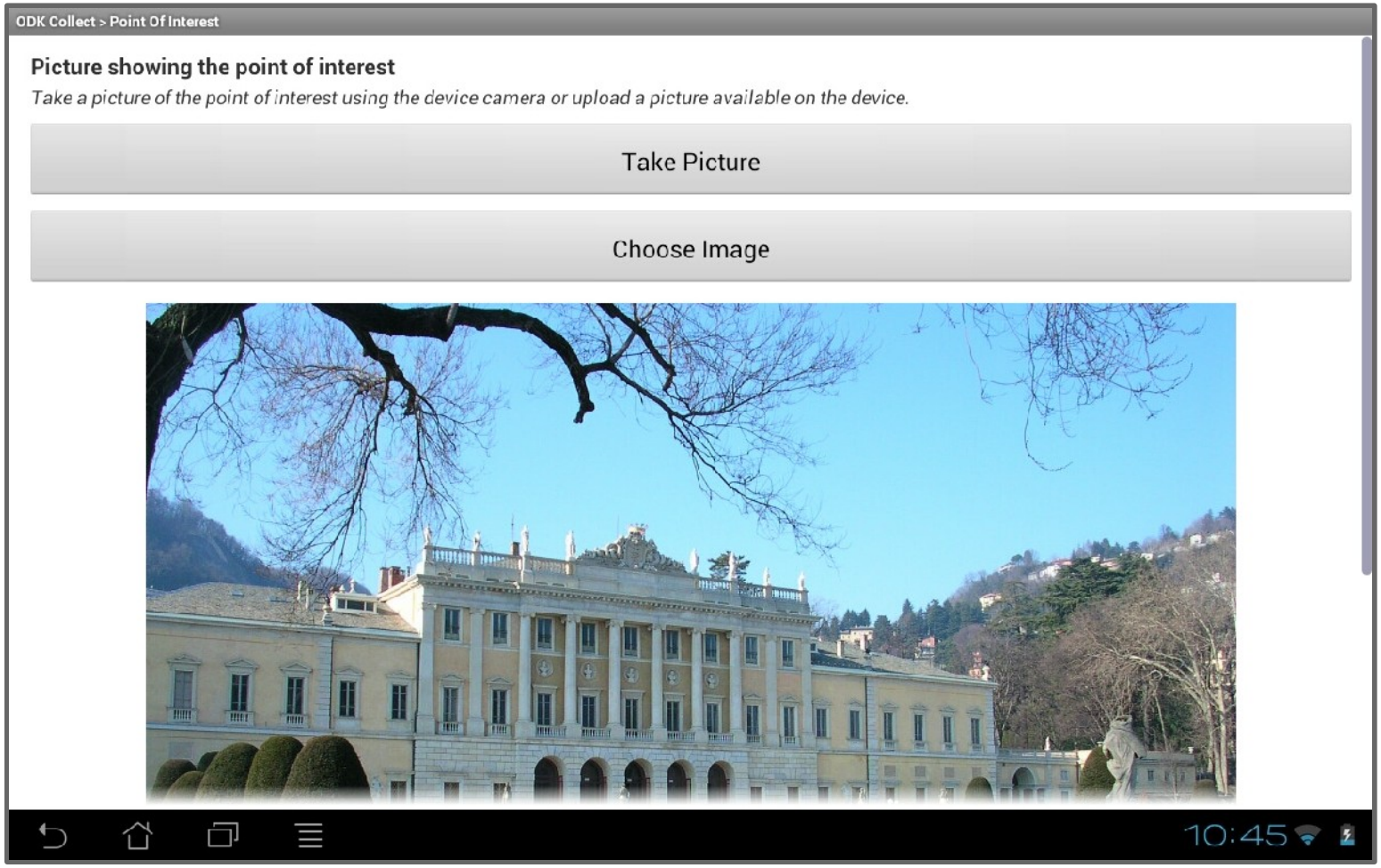

Data collection

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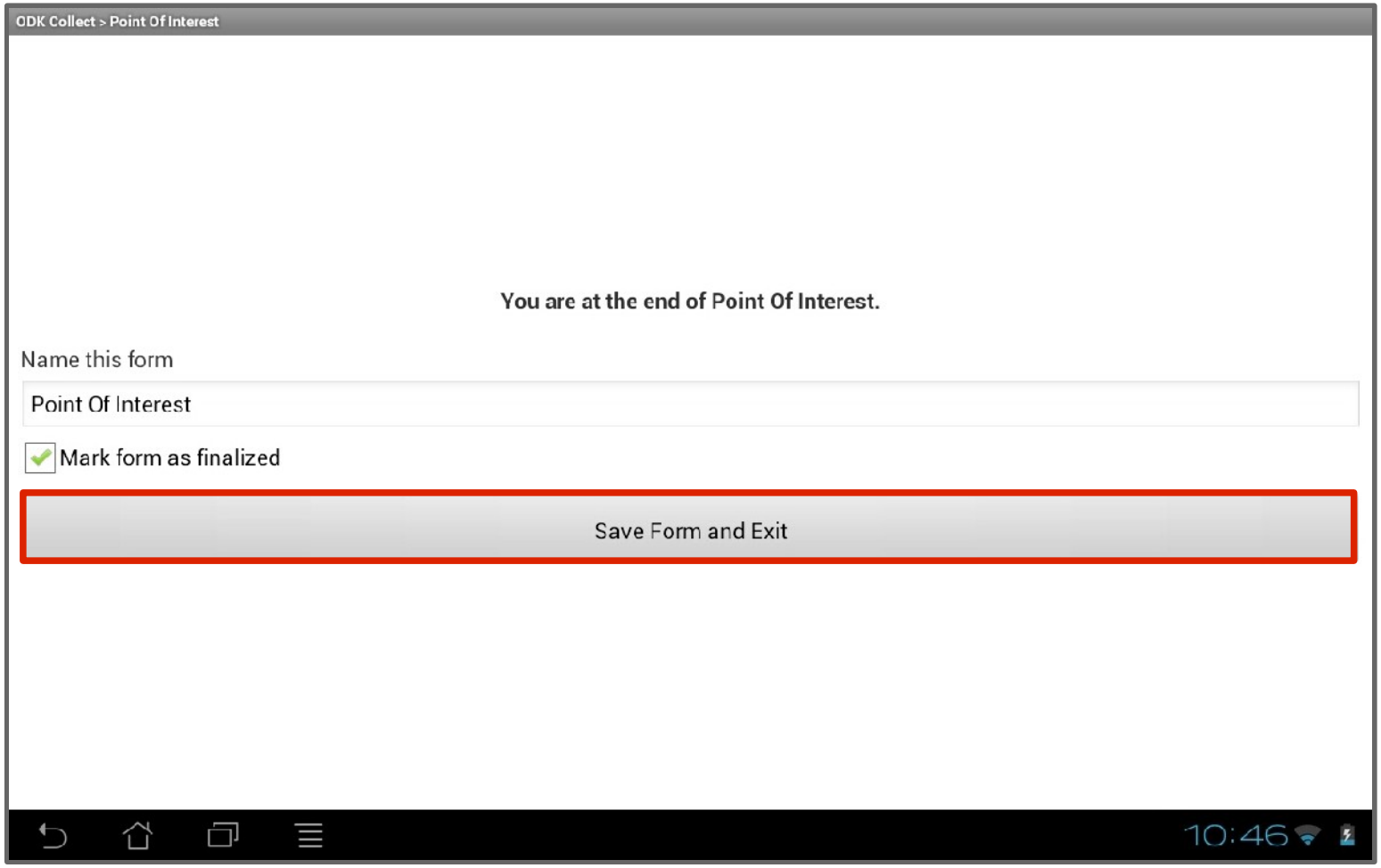
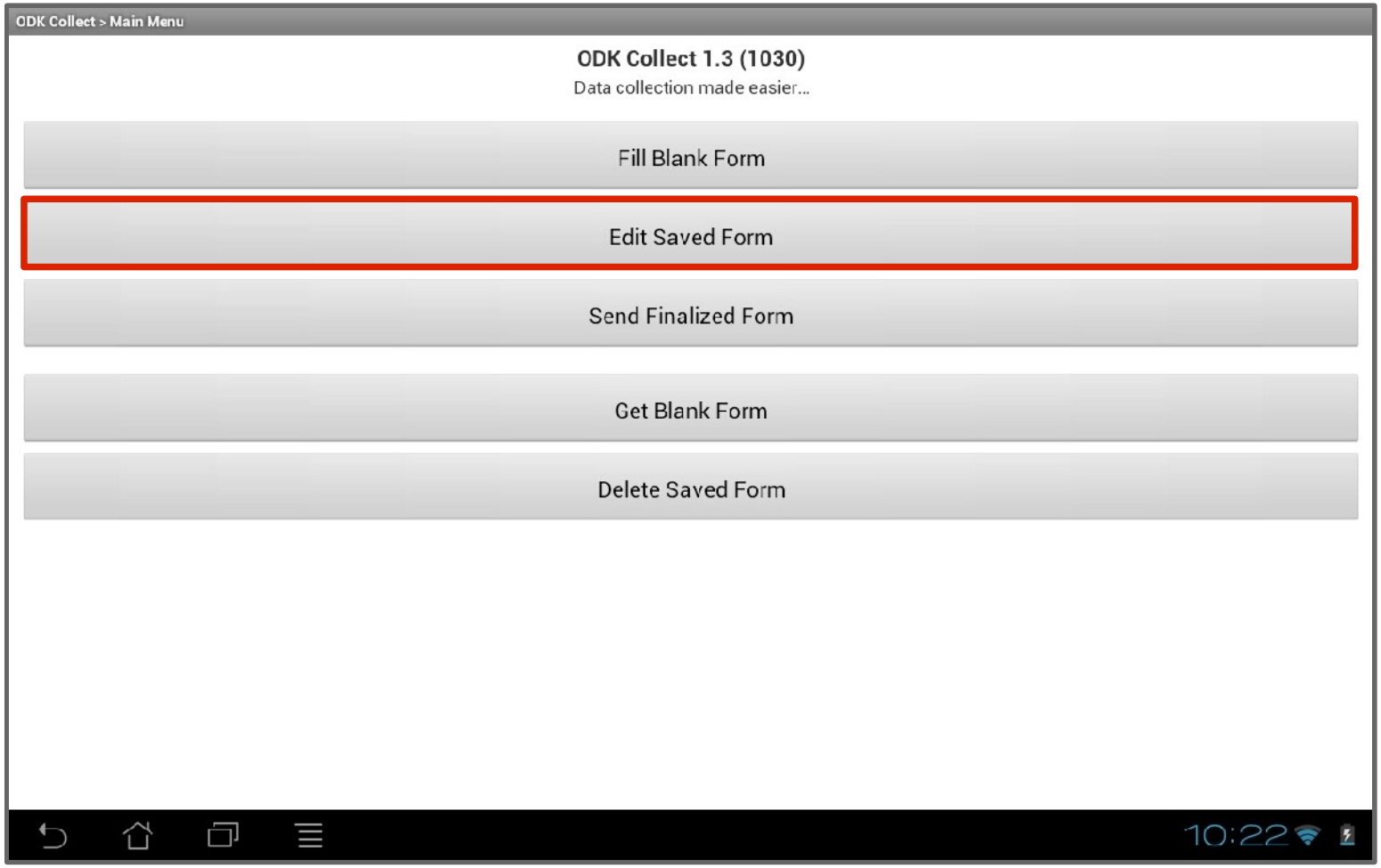


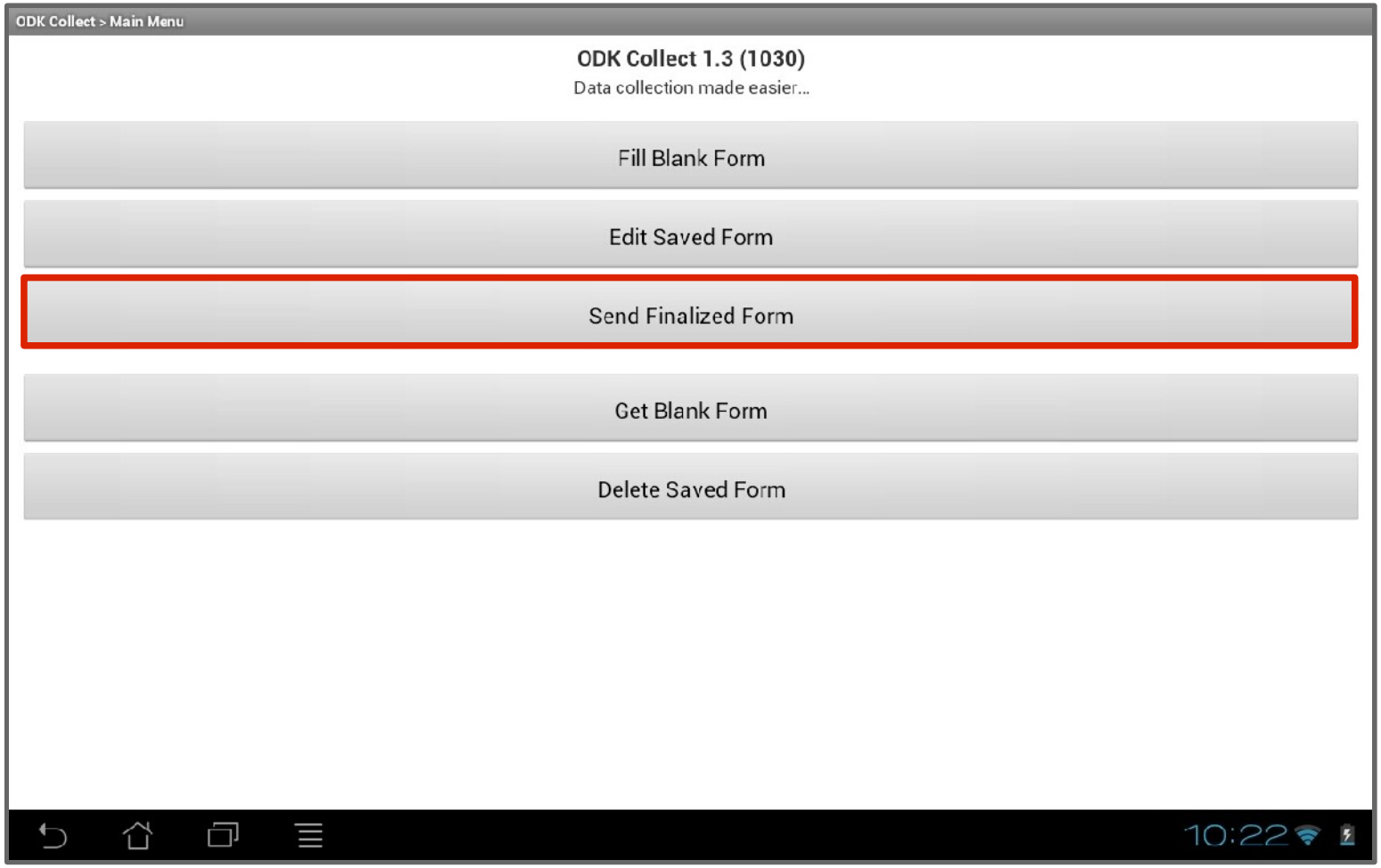
Data collection

- Application main menu



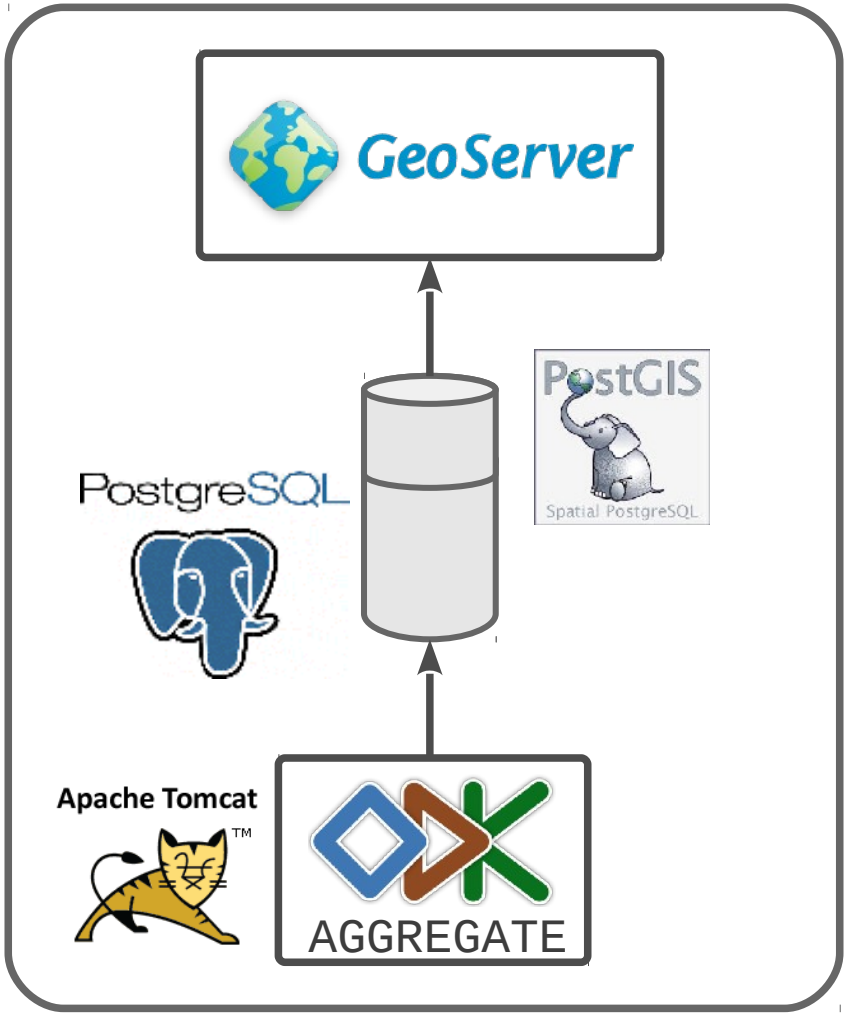
Data collection

- Application main menu

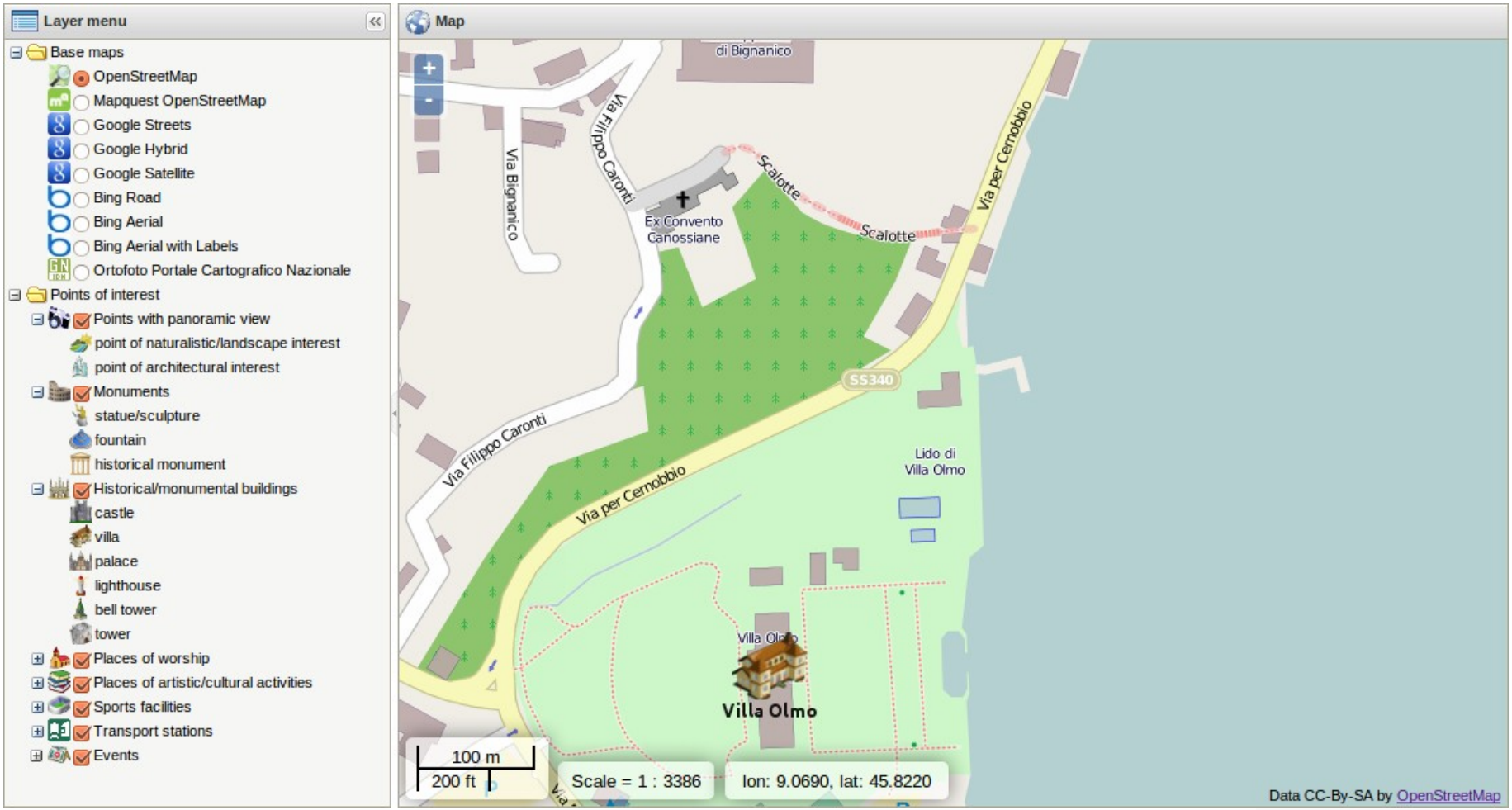


Storage and publication

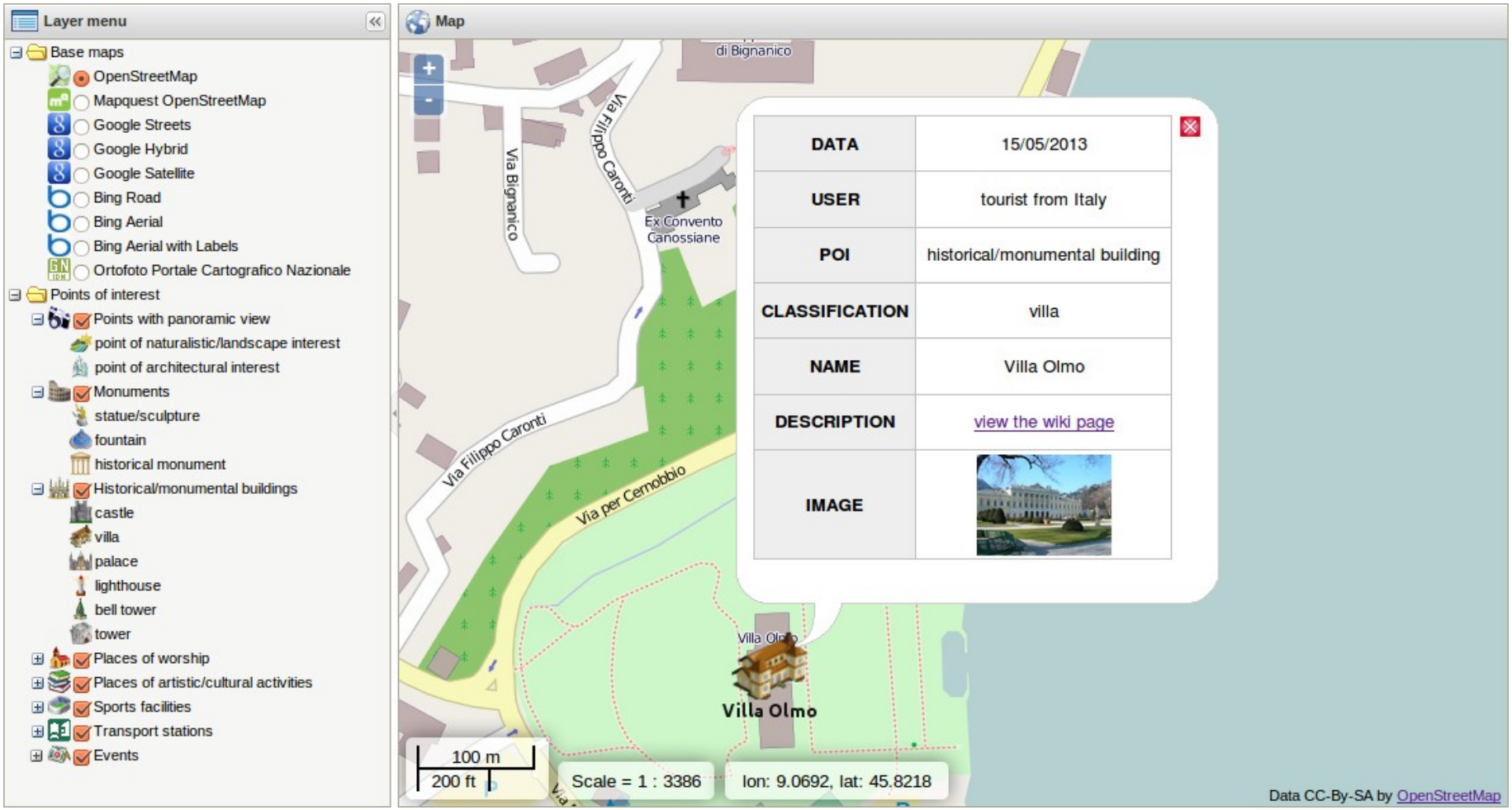
SERVER



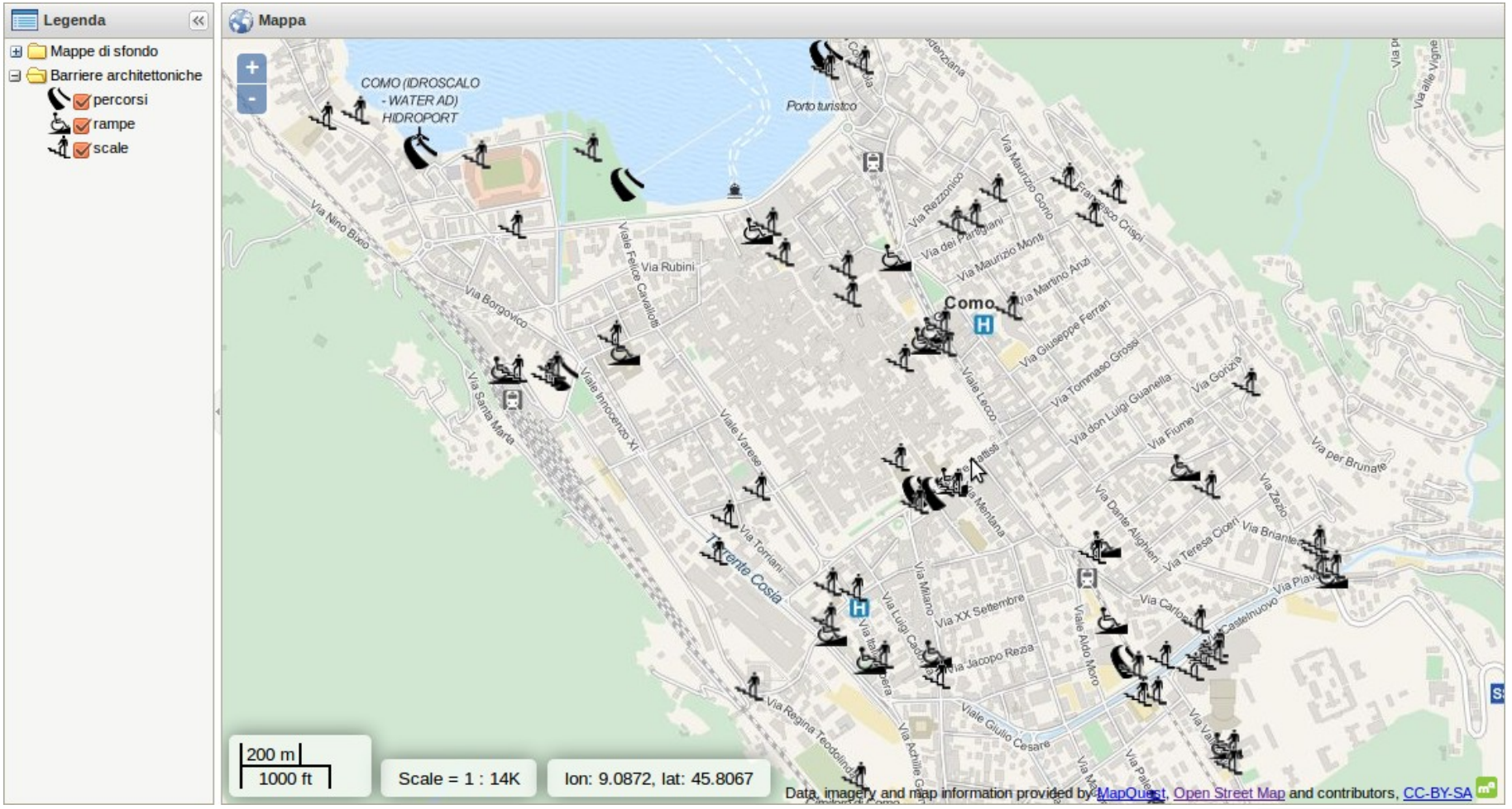
2D view - computers



2D view - computers



2D view - computers



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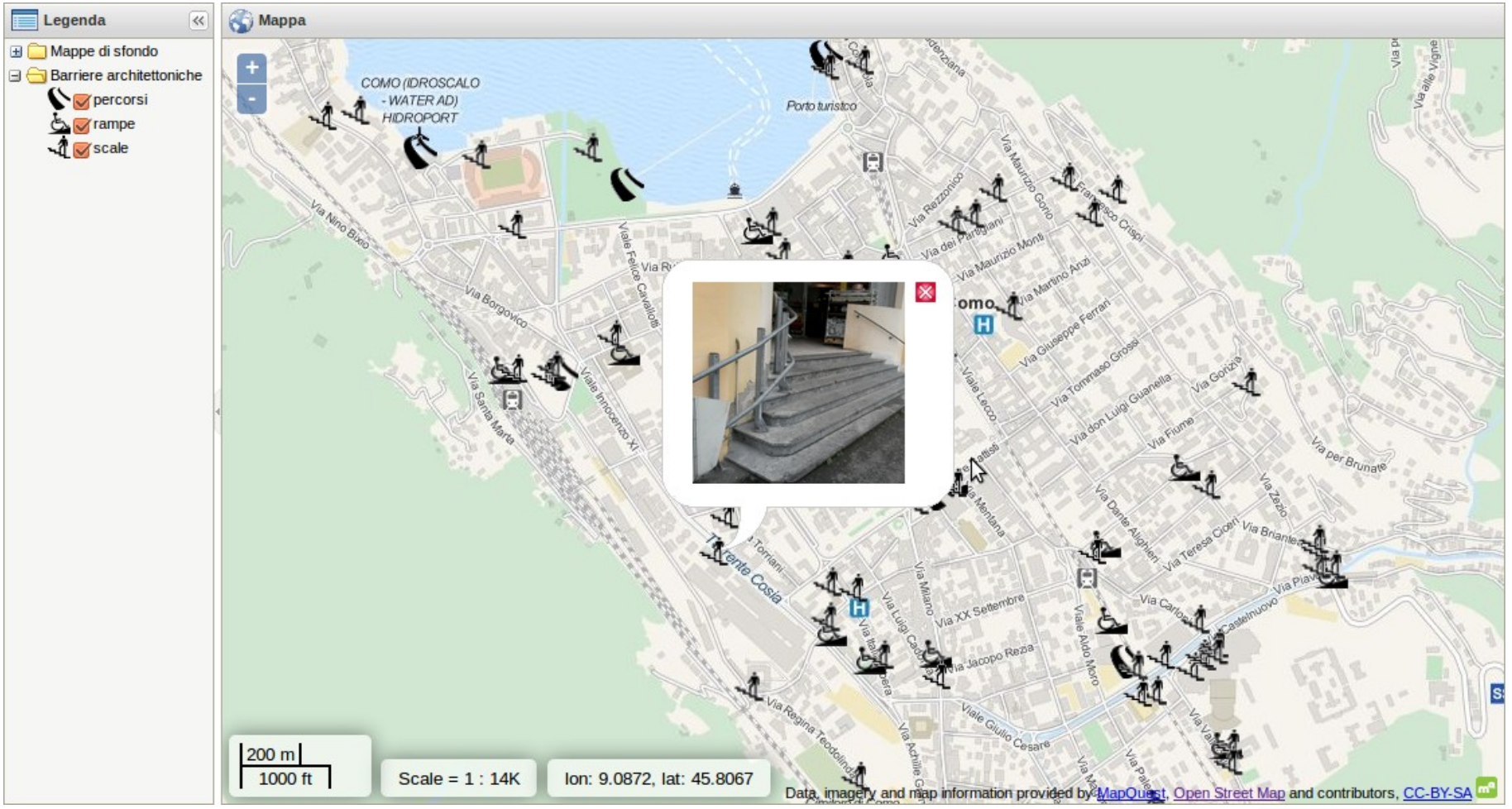
2D view - computers



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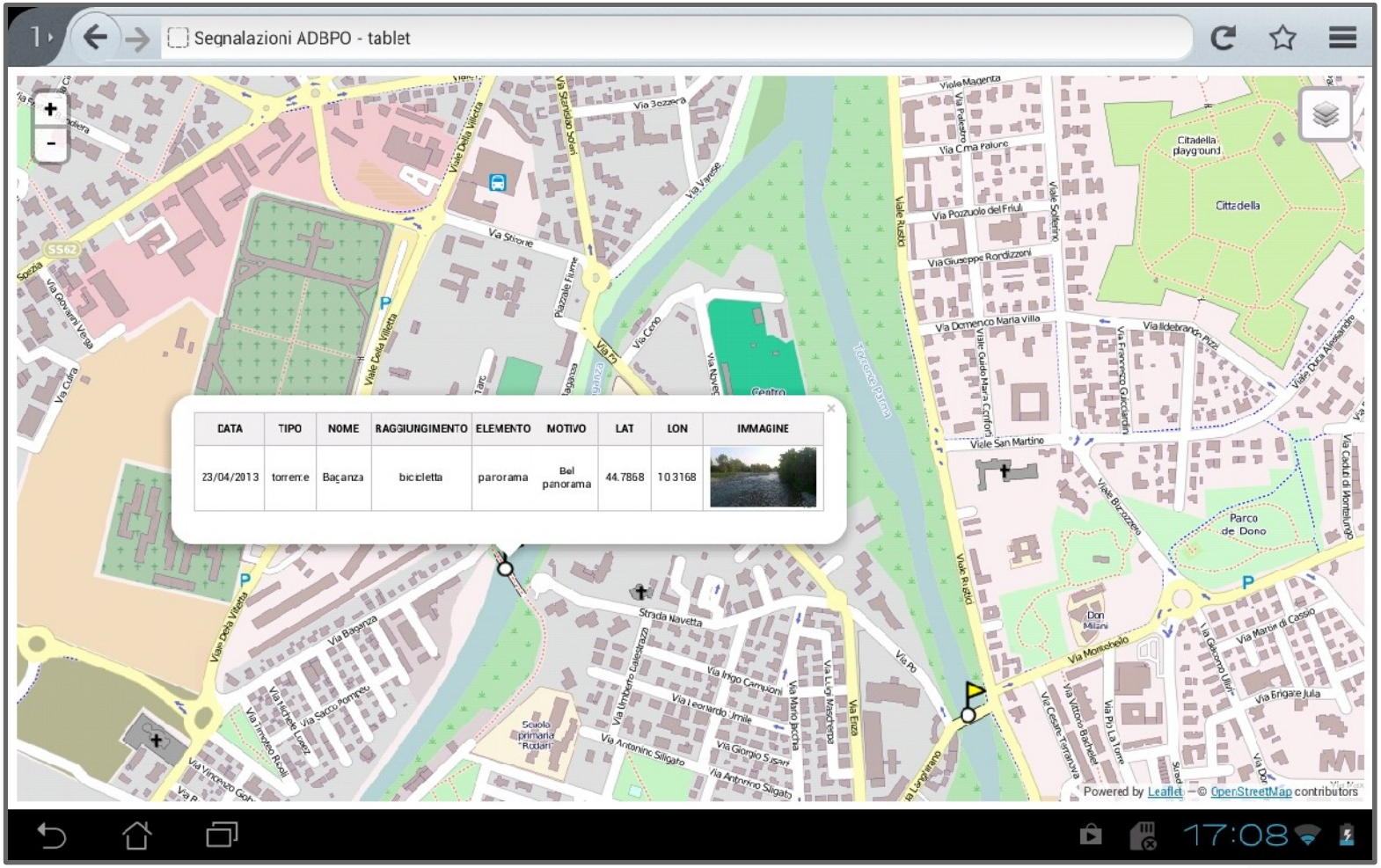
2D view - tablets

Leaflet



2D view - smartphone

PoliCrowd

- PoliCrowd is a Web-based 3D Participatory GIS platform
  - http://geomobile.como.polimi.it/policrowd
  - born to promote tourism and cultural heritage
  - interaction with user mobile devices for uploading Points Of interest (POIs)
  - POIs three-dimensional visualization on World Wind virtual globe
  - user collaborative contribution in POIs characterization
  - creating, saving and sharing customized maps with the community

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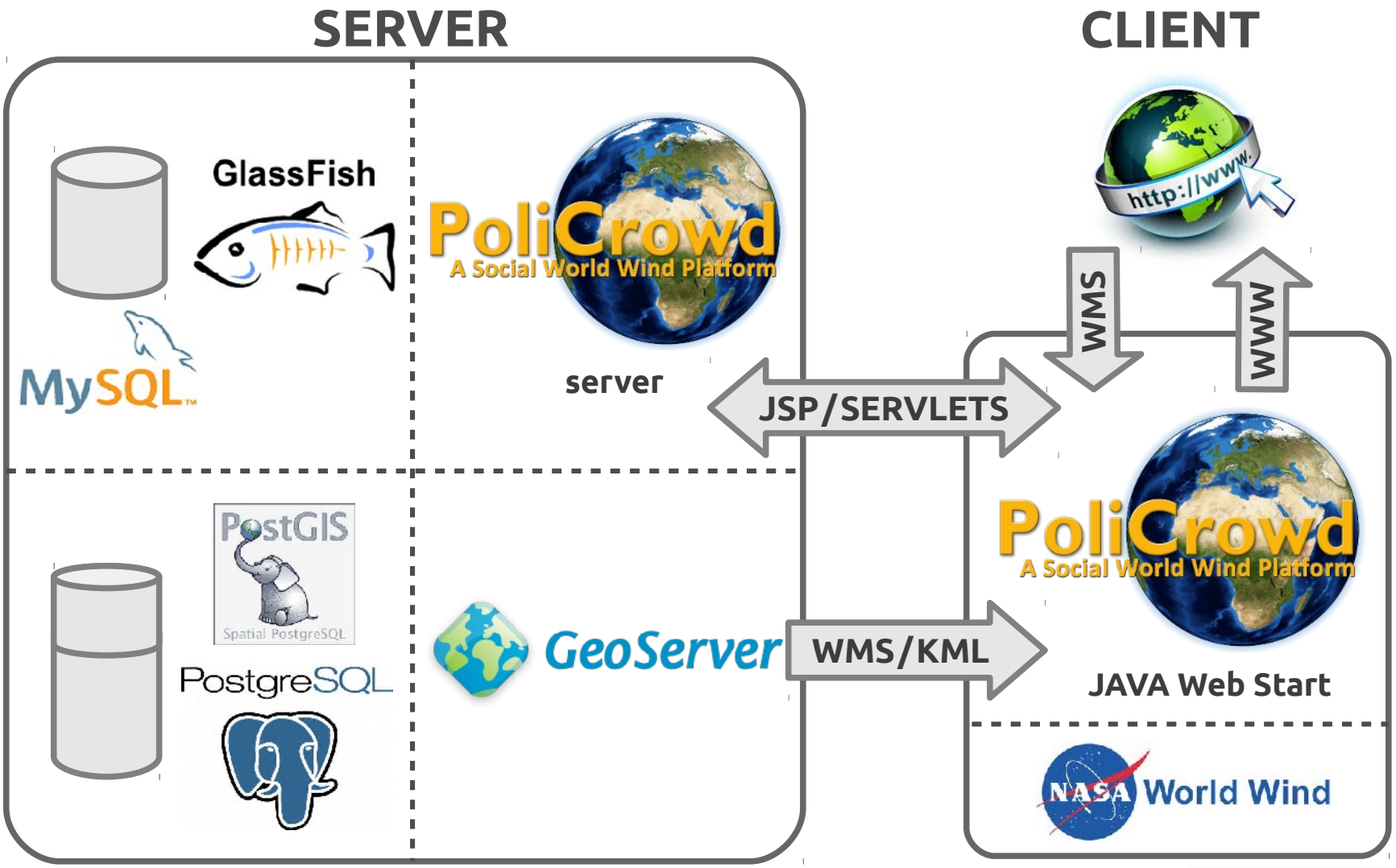
NASA World Wind

- NASA's virtual globe
  - http://goworldwind.org
  - free and open source under the NASA Open Source Agreement (NOSA) license
  - Java Software Development Kit (SDK)
  - multi-platform (Java: “Write once, run anywhere”)
  - JOGL (Java OpenGL 3D – Engine)
  - 3D Web visualization as Java Application, Java Applet or Java Web Start Application
  - based on open standards, accommodates any desired data format
- Main features
  - quality/accuracy control of horizontal (texture) and vertical (DTM) components
  - upload layers from OGC-compliant WMS servers
  - default WMS layers (i.e. satellite imagery and DTMs) from NASA and USGS
  - 2D objects (e.g. lines, polygons, markers) and 3D objects (e.g. parallelepipeds, spheres, extruded polygons) can be placed on the globe or in its surroundings

PoliCrowd architecture



Regione Lombardia

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3D data visualization

- Points Of Interest (POIs) retrieval from GeoServer
  - parsing of three KML files globally representing POIs
- Points Of Interest (POIs) 3D visualization on top of World Wind
  - access provided to all PoliCrowd users
  - POIs rendering through LOD (Level Of Detail) technique according to the altitude of the point of view over the globe:
    - first LOD: representation of all the POIs with a common icon (i.e. a pin)

3D data visualization

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  - POIs rendering through LOD (Level Of Detail) technique according to the altitude of the point of view over the globe:
    - second LOD: representation of POIs with icons showing their category

3D data visualization

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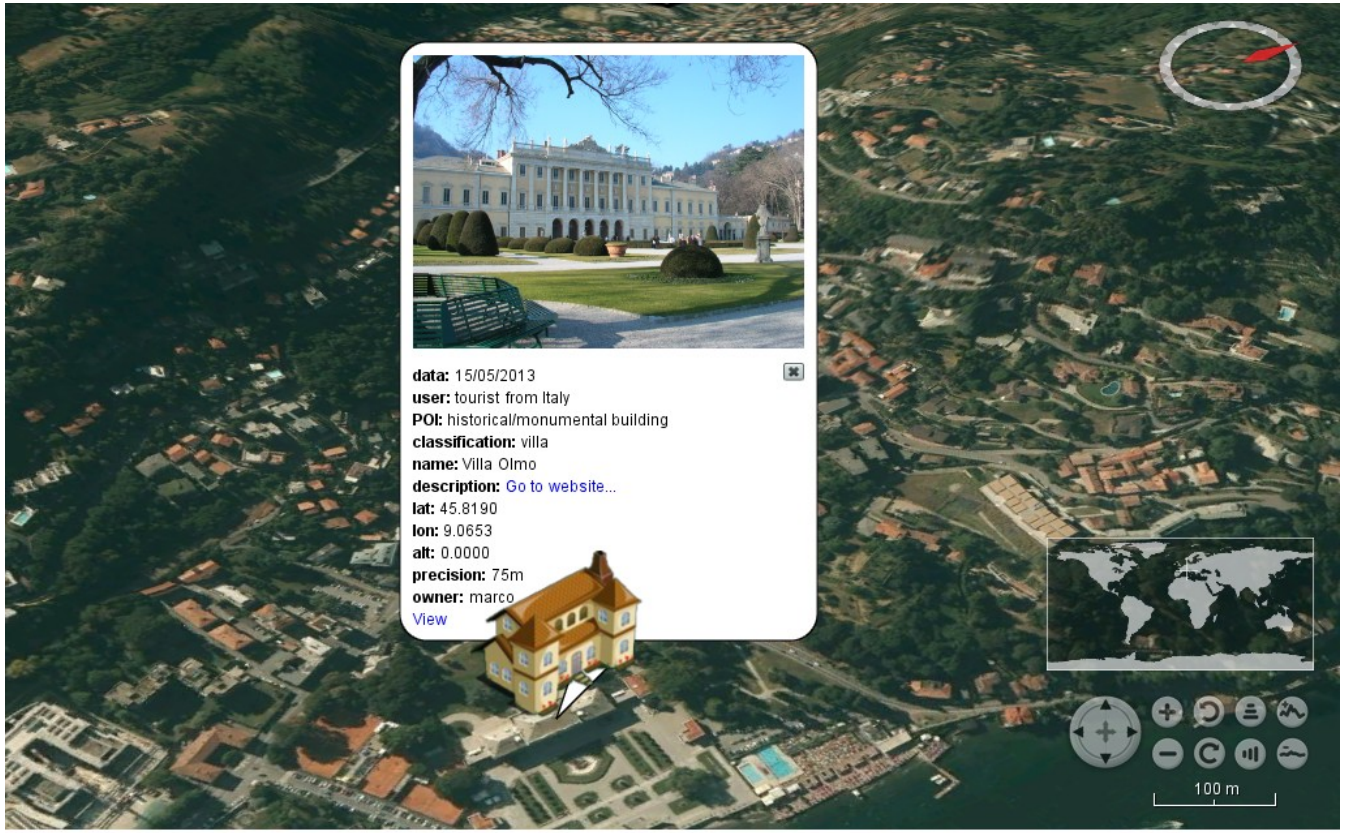
    - third LOD: representation of POIs with icons showing their classification

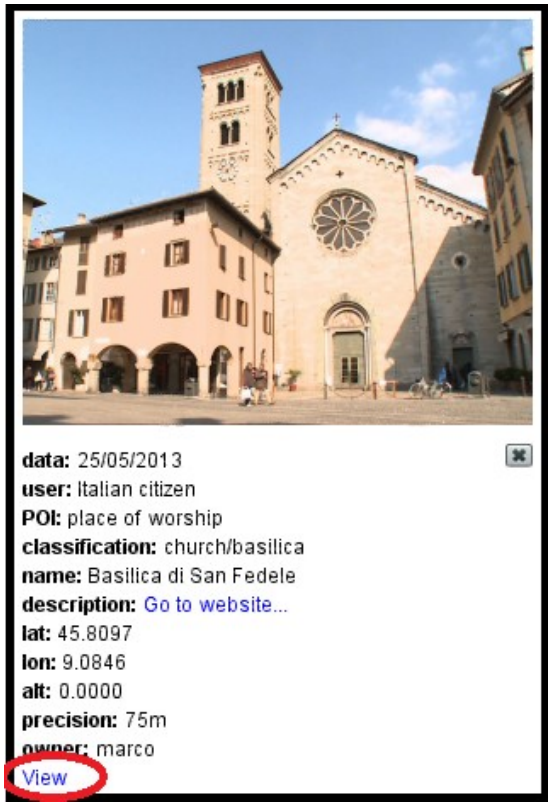
3D data visualization

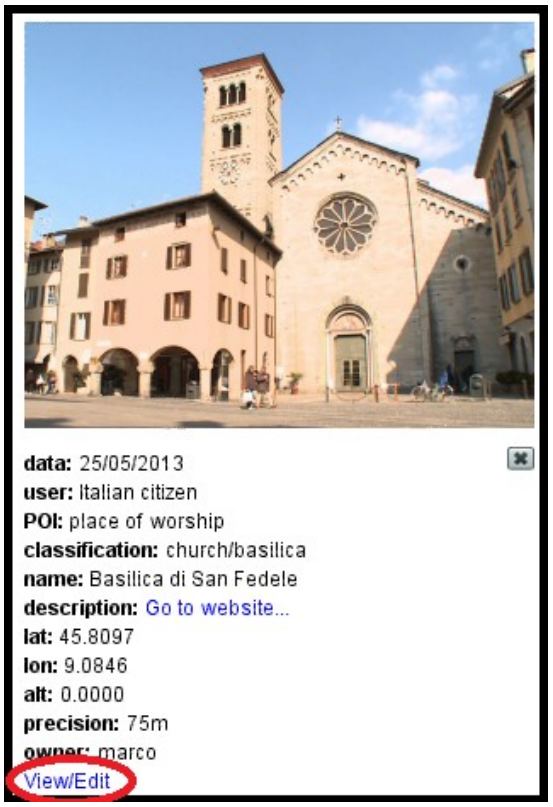
- Querying Points Of Interest
  - clickable POIs placemarks
  - visualization of Android ODK Collect-reported information in a balloon



Interaction with POIs

- Balloon access to POIs information according to user privileges
  - PoliCrowd non registered users provided with a *View* button
  - PoliCrowd registered users provided with a *View/Edit* button





Interaction with POIs

- Balloon access to POIs information according to user privileges
  - PoliCrowd non registered users provided with a *View* button
  - PoliCrowd registered users provided with a *View/Edit* button

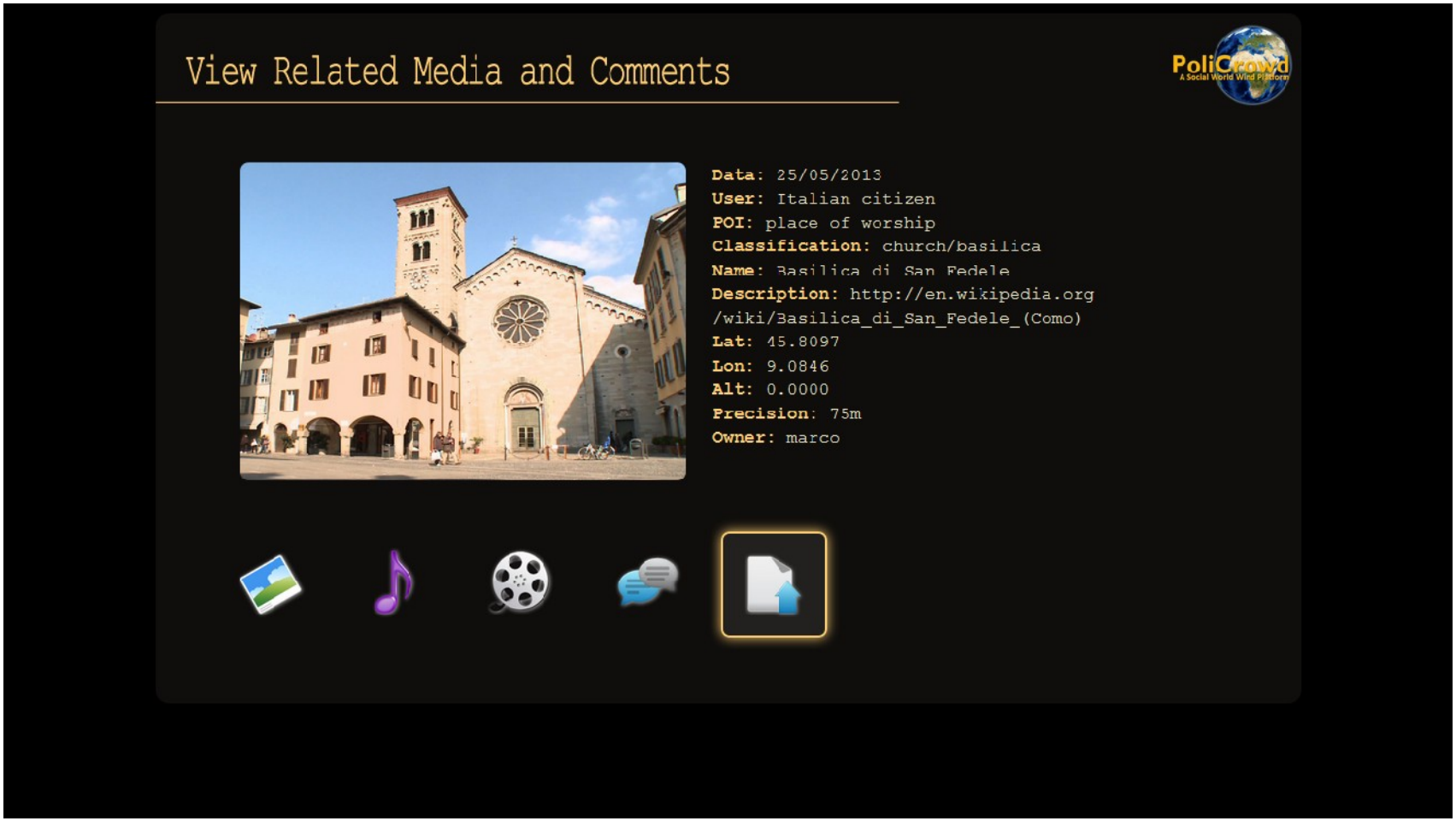
- POIs interaction based on user privileges
  - all PoliCrowd users - even if not registered to the platform - can access POIs description and view the contents added by registered users
  - PoliCrowd registered users can contribute to POIs characterization by adding and manipulating comments and multimedia contents (i.e. images, videos and audios)

3D data visualization

- View page for non-registered users

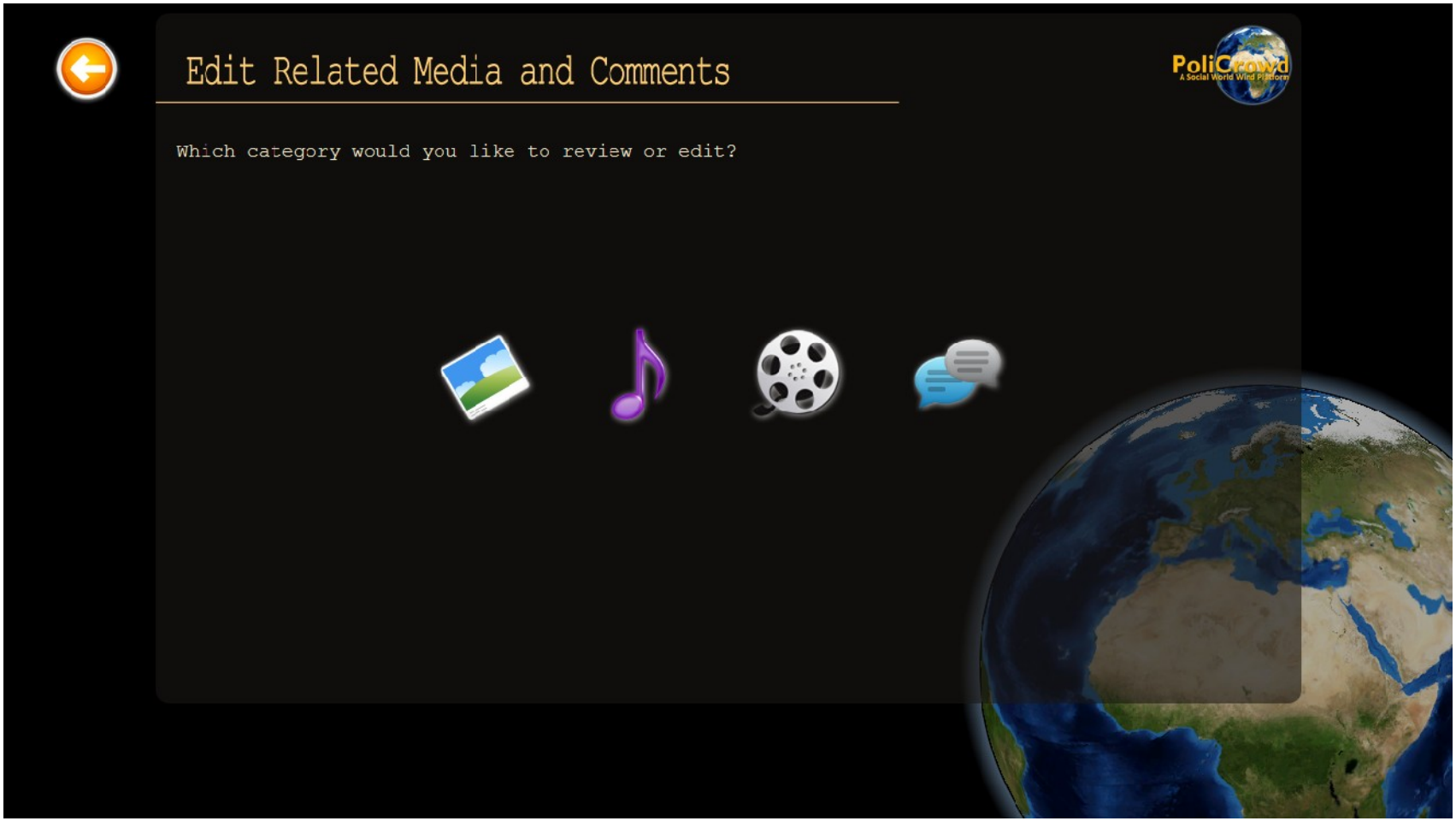
3D data visualization

- View/upload page for registered users



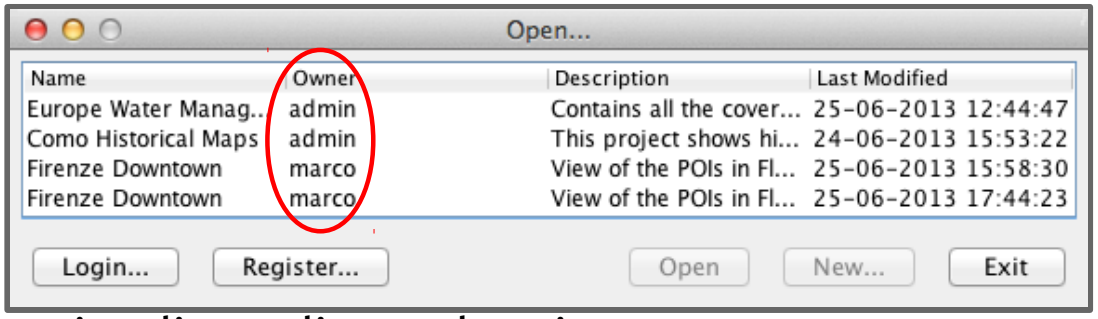
3D data visualization

- Add/edit comments and multimedia contents (registered users only)



Creating/saving projects

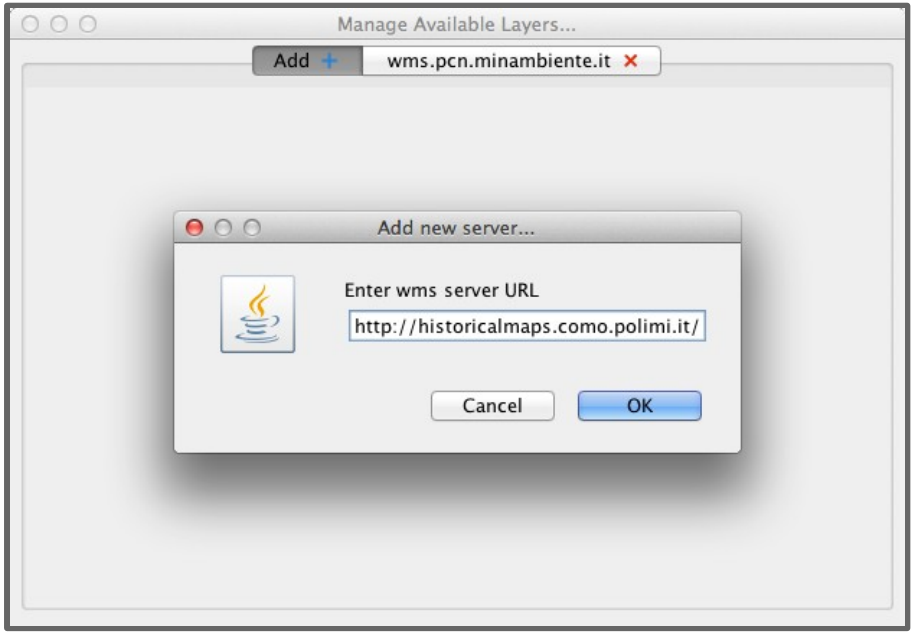
- Creation of a new PoliCrowd project
  - authenticated users can create a new project, entering a name and a description
- Saving a PoliCrowd project
  - storage of the current layers, the position (i.e. latitude, longitude and altitude) and the camera orientation of the point of view over the globe
- Visualization of user-created projects
  - all the created project feed a catalogue available for the whole community
  - the catalogue keeps trace of the project owner



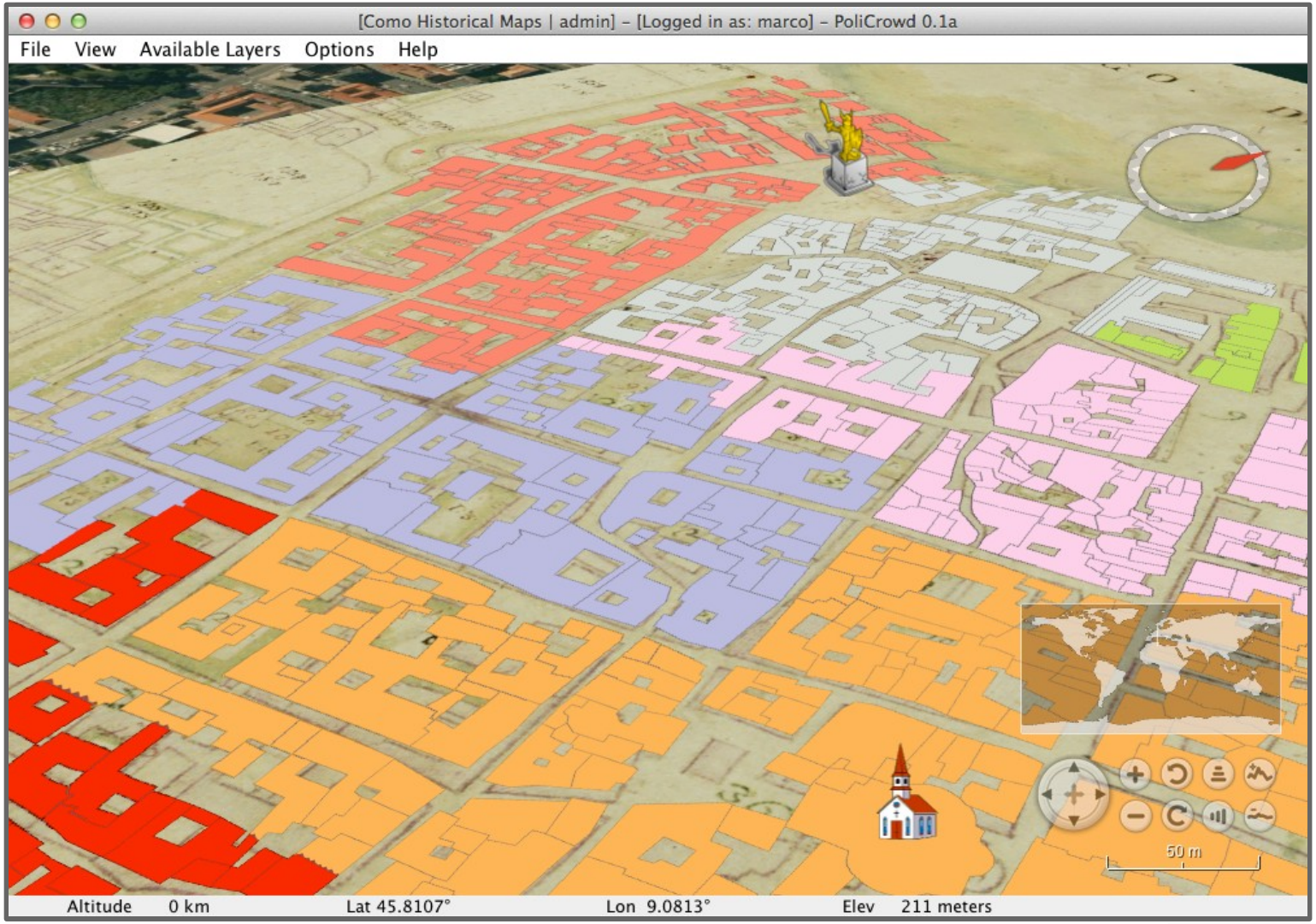
  - all users can visualize PoliCrowd projects
  - project owners have also editing options available

Adding WMS layers

- Adding layers from available WMS servers
  - option available only for registered users
  - users have to enter a valid WMS server URL and then select from the list the desired layer(s)
  - all the WMS layers added to a PoliCrowd projec feed a catalogue available for the whole community



Creating layer mash-ups



INTERREG
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POLITECNICO DI MILANO

I CAMMINI DELLA REGINA
percorsi transfrontalieri legati alla Via Regina

PoliCrowd team

- Winner of the first NASA World Wind Europa Challenge in Florence (http://eurochallenge.como.polimi.it)
- Team composed by
  - a mentor:
    - Giorgio Zamboni
  - 4 students:
    - Michele Bianchi
    - Marco Minghini
    - Rodi Jolak
    - Andrés Quiñones

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Conclusions

- FOSS architecture for a Web-based participatory GIS system
  - data collection on the field
  - data Web visualization and sharing
  - 3D fully-participatory platform
- Future improvements
  - extension of the ODK Collect app to overcome positioning problems (i.e. absence of GPS, poor GPS accuracy, mismatch between the position where the picture is taken and the position of the object being photographed)
    - ✗ positioning refinement through an interactive map
    - ✗ allowing positioning also for non GPS-enabled devices
  - synchronisation of user profiles on ODK toolkit and PoliCrowd platform

Acknowledgments

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