A blockchain-based framework for GDPR-compliant personal data processing

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Motivation

From 2018 GDPR strengthens the data rights of EU residents and harmonises data protection law across all member states

It has impact on any organisation holding personal data:

- more transparency to people about what data organisations collect about them,
- what those organisations use it for
- enabling people to prevent unnecessary data collection
- have full control over their personal data

It also increases the potential fines organisations face for misusing data

it requires (Art. 51) each member state to provide for one or more independent public authorities responsible for monitoring the application of the regulation, having access to all information necessary for the performance of their tasks.

Compliance to GDPR is then essential.

Sample scenario

Consider for example an online shopping service

- Throughout the sign-up process, the service collects consent and personal data such as name, address, email, and contact number.
- Users are requested to provide sensitive information for transactions about their bank account or credit card only when ordering products.
- All the collected personal data are recorded in a centralised database managed by the company

As regards GDPR compliance:

- personal data may not be directly and easily accessible to data subjects.
- Stored data may be not consistent with the consent or data given by the consumer, either by mistake (e.g., coding error) or on purpose.
- The changes (either of consent, or data) in the database might not be recorded in a log,thus not be traceable.

Blockchain as an authorization tool

Decentralising data storage helps:

- to record each interaction between the data subject and the service provider,
- bringing personal data processing to a level of privacy and security that prioritises data subjects and shared transparency,

Smart contracts can be used to encode GDPR legal requirements

- they are enforced automatically.
- becomes an access control manager that does not require a trusted third party
- blockchain can act as a tamper-proof ledger to record digital interactions

Framework for GDPR Compliance

A general framework that can be deployed by any organization for GDPR-compliant data processing.

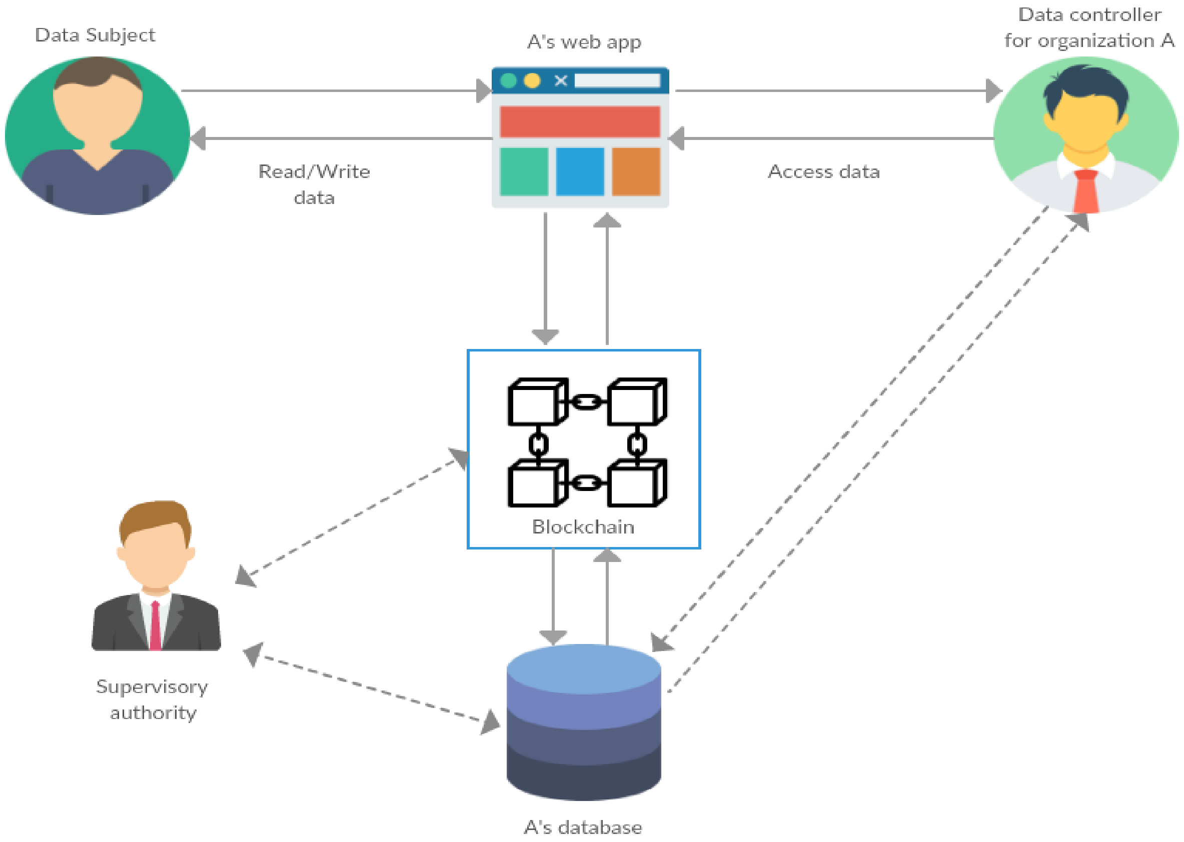
- combining blockchain and off-blockchain storage to construct a personal data management platform
- A smart contract works as an intermediate layer/interface/component monitoring and recording each interactionbetween the user, the organisation and data.
- In particular, it will ensure that data will be modifiable only by the subject.

The subject must have full control of the data entered during registration and the authorizations granted.

The actions performed on data and authorizations (entering, modifying, deleting) must be traceable

The supervisory authority, if requested, must be able to access the data and be able to carry out the required checks.

Architecture of the framework

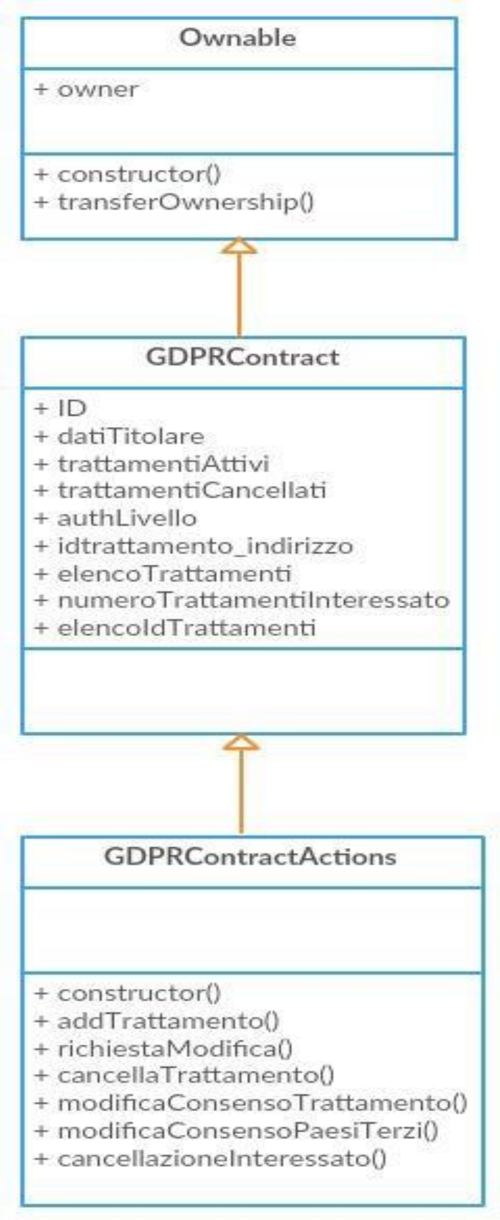


SMART CONTRACT

Contains all data structures required for storing authorizations

For each treatment, it stores an identified associated to the data treatment

Only those who are entitled to it can change the permissions granted



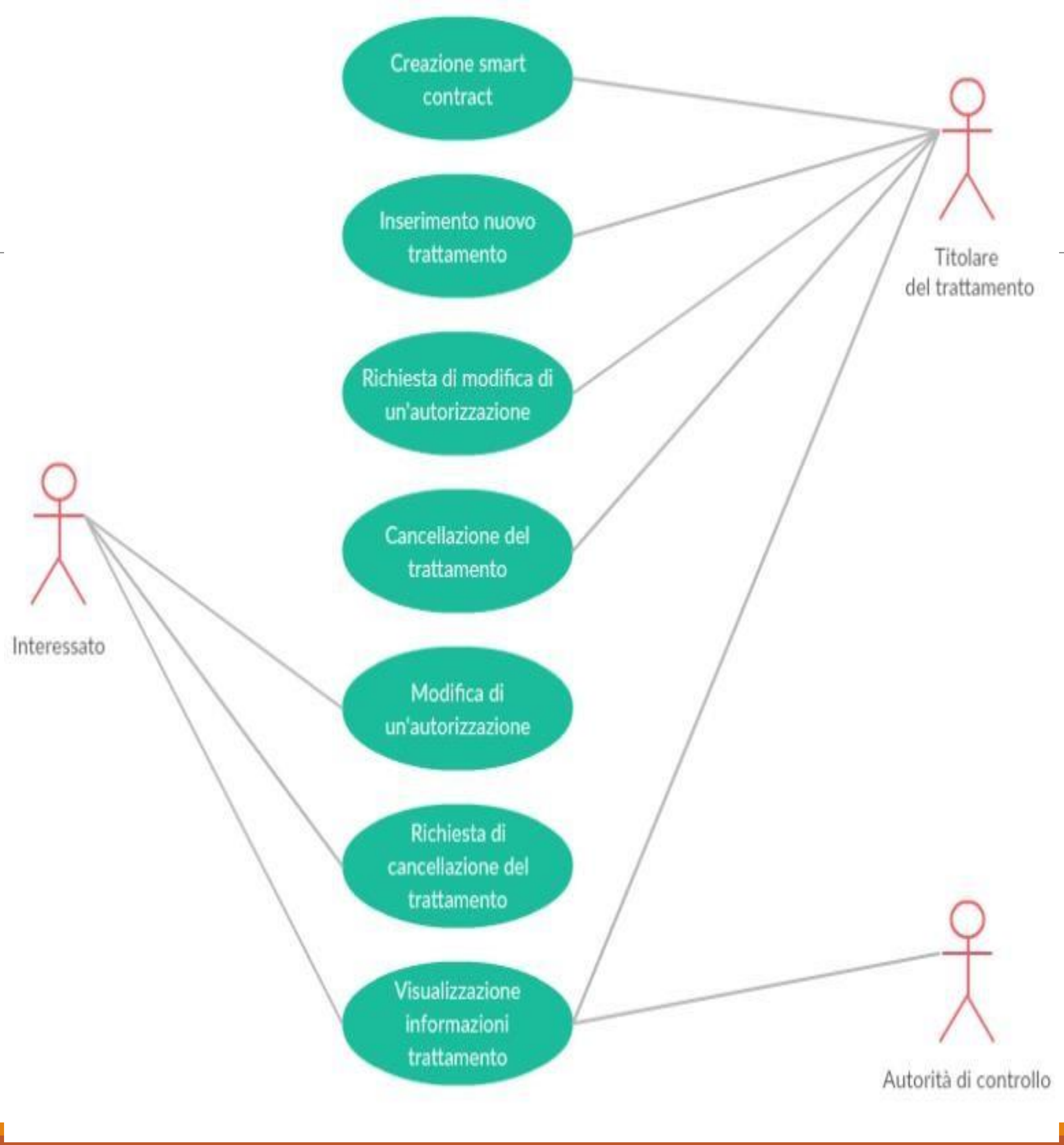
Java API

A Java library has been implemented and included in the prototype in order to facilitate the deployment of systems based on our framework.

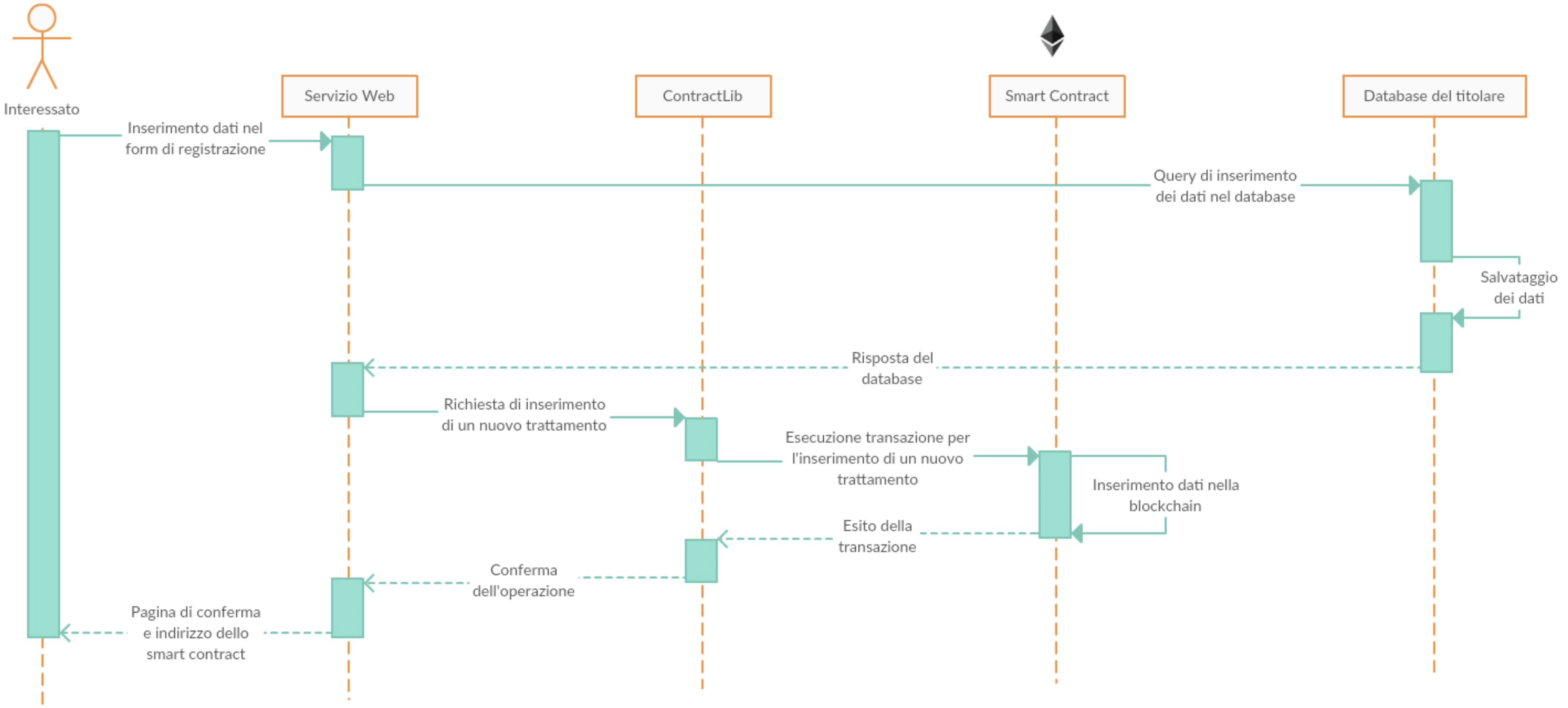
The library offers APIs to the functions of **GDPRContractActions** smart contract,
thus providing an abstraction from Ethereum.

By using the library, developers can implement GDPR-compliant client and server applications since by construction they meet the restrictions imposed by the GDPR and satisfied by the contract.

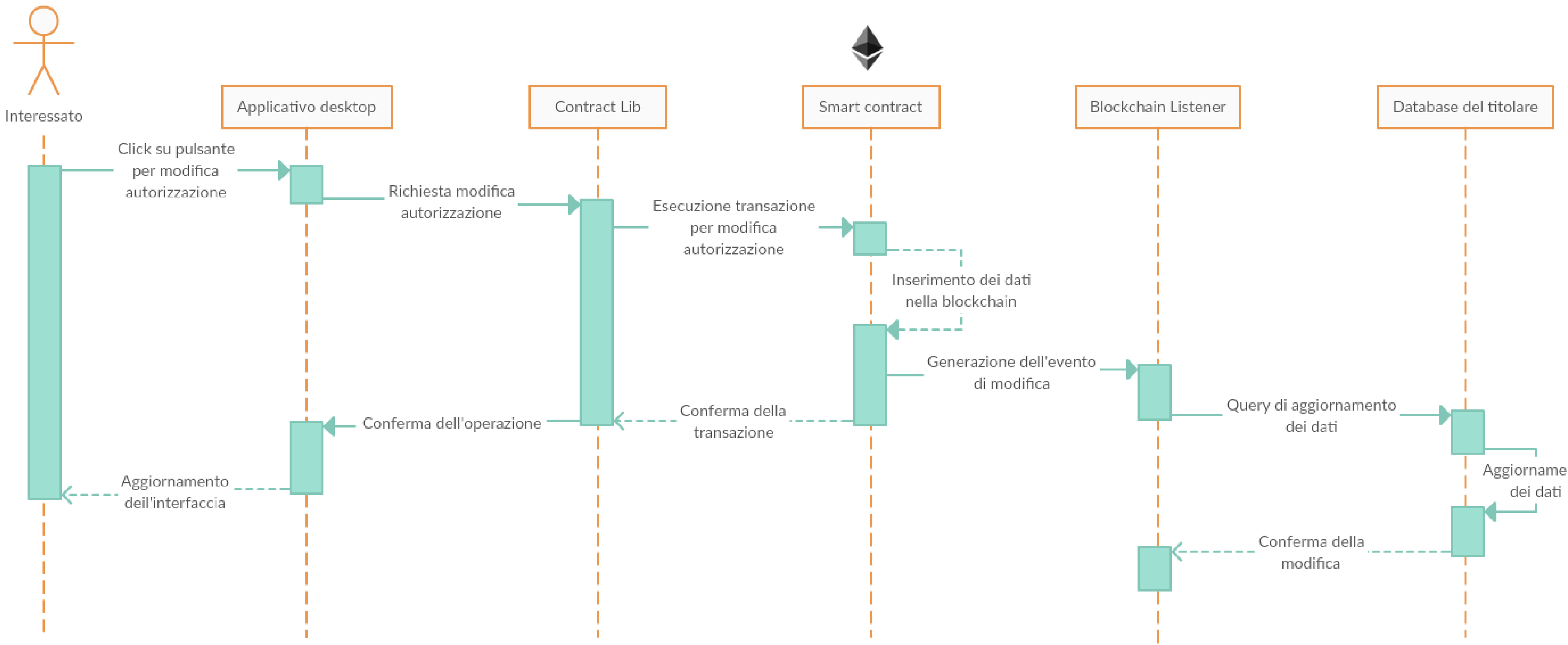
Use cases


Creazione smart contract
Inserimento nuovo trattamento
Richiesta di modifica di un'autorizzazione
Cancellazione del trattamento
Modifica di un'autorizzazione
Richiesta di cancellazione del trattamento
Visualizzazione informazioni trattamento
Titolare del trattamento
Interessato
Autorità di controllo

Registration


Interessato
Servizio Web
ContractLib
Smart Contract
Database del titolare
Inserimento dati nel form di registrazione
Query di inserimento dei dati nel database
Salvataggio dei dati
Risposta del database
Richiesta di inserimento di un nuovo trattamento
Esecuzione transazione per l'inserimento di un nuovo trattamento
Inserimento dati nella blockchain
Esito della transazione
Conferma dell'operazione
Pagina di conferma e indirizzo dello smart contract

Updating authorizations


Interessato
Applicativo desktop
Contract Lib
Smart contract
Blockchain Listener
Database del titolare
Click su pulsante per modifica autorizzazione
Richiesta modifica autorizzazione
Esecuzione transazione per modifica autorizzazione
Inserimento dei dati nella blockchain
Generazione dell'evento di modifica
Query di aggiornamento dei dati
Aggiornamento dei dati
Conferma della modifica
Conferma della transazione
Conferma dell'operazione
Aggiornamento deil'interfaccia

Conclusions

The newly proposed system therefore represents a complete environment capable of integrating the smart contract with a corporate service.

Thank to the use of the proposed library,

- the developers can realise client and server applications for the needs of the company and customers
- smart contract can be adapted
- meet the restrictions imposed by the GDPR.

Future works:

- Compatibility and integration with already developed services
- Simplified interaction
- More detailed analysis (security and cost analysis, formal/semi-formal)