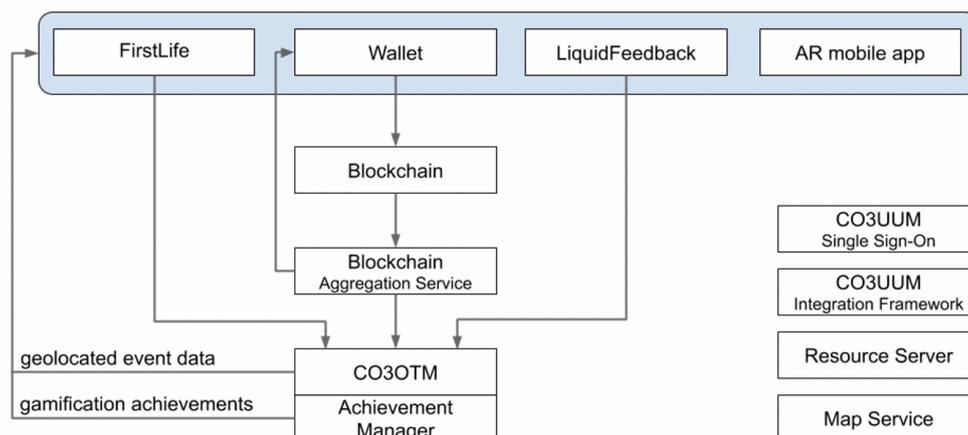


Implementing disruptive technologies at the CO3 project is translated into a platform composed of several modules, each of those implementing several toolkits, frameworks, and protocols. Some of the modules used in CO3 come from previous developments. The handicap is to modify and integrate additional services and protocols to enable the modularity and let certain independence for each partner to add additional functionality and update the tool that they provide inside the CO3 platform having the lowest impact as possible in terms of development changes to the other partners that use/consume the functionality provided by their tool. The technical experts have chosen two approaches to enable interoperability. For the user interface side, we have the WebViews, which are embeddable components inside a parent interface. In the case of the CO3, it's determined by a "LandingPage" in the web version that integrates the main toolbar with the basic user's session management and the different buttons to change the view to LiquidFeedback, FirstLife, and the blockchain wallet. In terms of the CO3 AR APP, there is a three tabbed-based interface developed in UNITY which allows the user to change between the AR interface, FirstLife, and the blockchain wallet. Technical speaking, the CO3 platform comprises nine modules: four are entirely graphically visible by the end-user, and the other six are parts of graphical interfaces and APIs. Figure indicates the different modules.



LiquidFeedback

The module which provides the interactive democracy, is a mature open source software which has been under active development since 2009. LiquidFeedback is built in two layers:

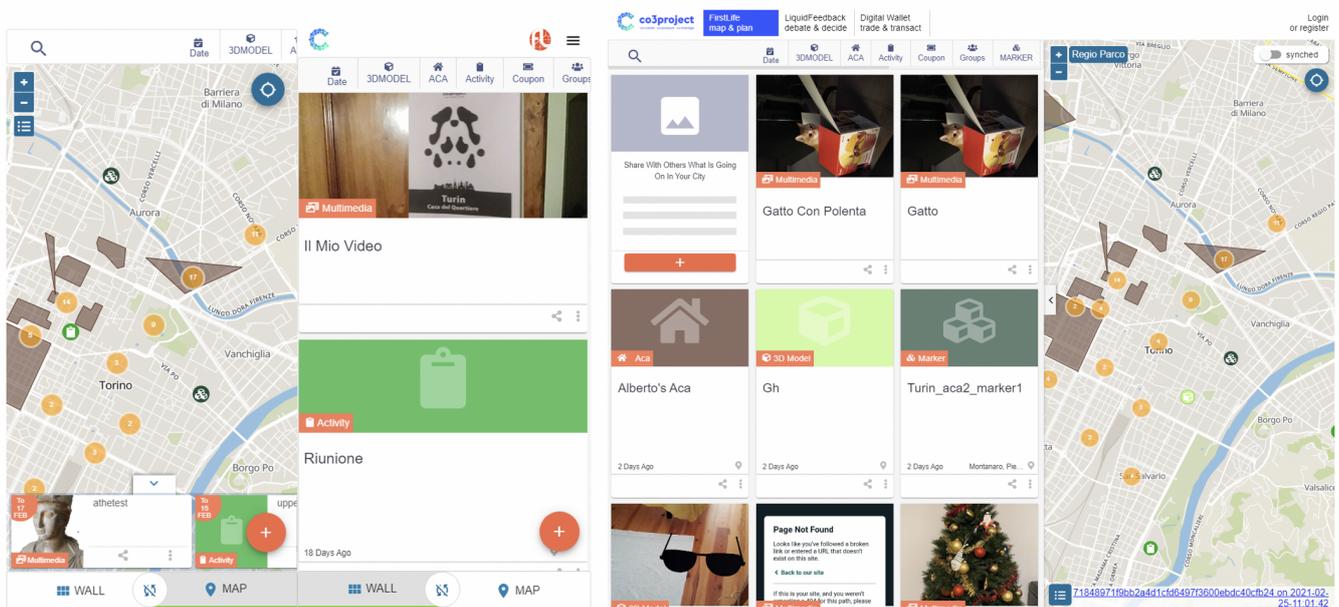
- LiquidFeedback Core is a database application written for the open source database management system PostgreSQL and consists of the data storage, the business logic and the algorithms controlling the proposal development and decision making process.

- LiquidFeedback Frontend implements all interactions between users and the Core via a web interface as well as an application programming interface (API) for automatic data processing. The progressive web interface is accessible using both desktop and mobile devices.

LiquidFeedback's integrated OAuth2 authentication service provides the CO3 unified user management along with further integration services, especially the meta navigation bar. Integration services with FirstLife allow attaching LiquidFeedback content to geolocated objects. Based on work during the CO3 project, the upcoming version of LiquidFeedback will allow to adjust users' voting weight based on blockchain tokens.

FirstLife

The module which provides the geolocated network support, FirstLife, is developed using different technologies. The front-end interface (web + mobile) uses Angular as the framework for rendering the user's views. That approach creates a highly interactive and responsive interface as it is a requirement for providing real-time information over the 2D map.



Blockchain (Digital wallet)

The digital wallet is also a web app as the other interfaces. For this case, the engineers of Apeunit decided to use ReactJS as the framework for generating the user interface. ReactJS provides the functionality of user-side rendering. This means that the web app only interacts with the CO3 server to download and upload data without making additional requests to generate the user view or react to the user's changes. The digital wallet uses GraphQL to get/send the transactions to the Ethereum server provided by UNITO.

OnToMap

OnToMap, as an interchange API server, is not a visible module. This means that the final user is not aware that this critical part of the CO3 platform exists. The decision to create this module is to provide interoperability of the data between the CO3 modules. The kind of interchanged data is; user profile, events of task creation at the geolocated map, logs, gamification achievements, geographic attached objects, metadata about AR objects, among others. Without the inclusion of this tool, it may imply the bilateral implementation of APIs to interchange information between each pair of interfaces, in other words, a total of six different combinations of information protocols.

Augmented Reality interface

The AR APP is developed with the Unity framework, using the included bindings for ARCore/ARKit. That APP can run under iOS and Android, making it possible the interaction with the real environment in real-time.

Lessons learned

Athens's pilot

- Citizens are open to explore new technologies proposed by the city and to adopt to new services and applications after proper introduction and walkthrough.
- The usability and ease-of-use of new technologies is proportional to the level of their adoption both by the city and the citizens as end-users.
- Local society is highly sensitive to matters referring to social policy and willing to explore new forms of co-management of relevant services that CO3 proposes.
- The integration of CO3 tools in one application is of utmost importance for the perception of the user and long-term engagement in the pilot activities.
- Technologies like AR that require specialized equipment, e.g. the latest versions of smartphones, are on one hand inviting to end-users due to its modern interface and features, but also not easy to diffuse in the society for economic reasons. However, CO3 has developed the feature for both Android and iOS in order to tackle the diffusion of the technology.
- Digital wallet features might receive hesitation from the end-user due to its connection with money-exchange. However, in flea-markets younger producers are more familiar and less hesitant than older age-groups.
- End-users show high interest in co-creation processes and their results. Also, citizens engaging in the co-creation of services perceive the assets of their city as commons and thus the policies from such activities have wider impact in cities. The maintenance of policies is also expected.
- New policies that oppose established legal and accounting/economic constraints in Greece are more difficult to be implemented due to the procedures necessary for updating the relevant frameworks and proposing new ones. The latter procedures are an obstacle for legal and financial regulations to change or be renewed.

Paris's pilot

- Local citizens are sensitive to matters concerning urban commons and ways to manage them.
- CO3 technologies have a huge potential for didactical/pedagogical activities.
- Professors and Education Institutions are inclined to change and innovate their programs and the way they teach if the technologies proposed are up to their expectations.
- In France, the legal restrictions imposed for the use of applications have weakened the possibility to reach a vast number of active users of CO3 technologies within the schools (<16 y.o.).
- Technologies presenting similar features of the apps known by the general public have proven to be more understandable, hence adoptable by local actors. The user-friendliness and intuitiveness of Augmented Reality have played an important role in the adoption of this technology by stakeholders.
- The co-design methodology has proven its efficiency for both for creating services and to respond to the demands of local stakeholders, but it is difficult to highlight the potentialities of previously unknown technologies such as Blockchain.
- Given the type of scenarios co-designed with stakeholders, the socio-economic and cultural situation of the territory, Blockchain technology's implementation has been reduced from initial expectations.
- The COVID-19 situations have weakened the adoption of new local, community-based behaviour that CO3 technologies were aimed to foster and/or reinforce. However, it has raised the interest in the Blockchain technology for its crowd-sale and crowdfunding features that could be vital, even if only momentarily, for the local commerce and territorial economy.

The project has its starting point in the collaborative definition of service concepts to assess a new collaboration model between PA and citizens through technologies.

Turin's pilot

- The user interface must be simple and capable of actually making the organisations' and citizens' interaction in the Case del Quartiere easier and more effective, otherwise the CO3 app will not be used.
- The augmented reality technology has high requirements in terms of smartphone performance, and the smartphones needed to run the AR app may not be available to many of the citizens/organisations.
- The use of blockchain technology for payments is very recent and all the legal and fiscal aspects have to be made very clear so that all the organisations involved can feel confident in its use.
- The choice of blockchain payments instead of traditional payments, the purchase coins by the public, the adoption of the coins by organisations need incentives on both sides (citizens and organisations).
- The Covid 19 restrictions (the Case del Quartiere as cultural and recreational centres are currently closed, only the educational and social services are open) require a change in the approach of CO3, which originally required physical presence to interact with the App; corrections are needed in order to allow remote actions in this period of social distancing.

Policy implications

1. Provide an application walkthrough/course: Citizens are open to exploring new technologies and adapting to new services and applications, but the usability and ease-of-use of new technologies are proportional to their adoption level. This is why each platform's module could include an interactive tutorial (walkthrough) that shows the basic functionality to anyone who uses the CO3.
2. Persuade local organizations/administration: Convince local organizations that the CO3 co-creation mechanisms do not put their form of government at risk but rather complement it. Show them examples of new forms of co-management.
3. Scale depending on the device: make adjustments to the CO3 platform software to different devices, providing the technology according to the device you have and not the other way around. If it is impossible to offer an AR environment, provide basic services based on geolocated map technologies and user geopositioning.
4. Regulated transactions: Provide different methods for converting credits (real money) to tokens and vice versa compatible with the legislation. Due to financial regulations, it may be necessary to report transactions in the CO3 blockchain system to avoid government impediments.
5. Choosing the public: Before implementing CO3 in an extended way to all the pilots' users, it would be convenient to gather their expectations to decide the use cases they want to test in that group. Since through co-production, new forms of interaction are explored, as well as new limitations.

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