A blockchain-based object sharing system for local communities

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ABSTRACT

This paper aims to demonstrate how blockchain technology can enhance the reuse of unused items by facilitating the lending of physical goods in local sharing economies. While in many local communities this type of interaction between citizens is already established informally, we propose a model that helps to digitalize the process without crowding out interpersonal relationships within citizens. This is achieved by making a digital twin of each item via a totally decentralised lending management system where each loan takes place between two parties without any mediator. This lending system is available to local communities through a web application we developed as a submodule of CommonsHood , a comprehensive wallet app designed to provide civic communities with the necessary tools to encourage active civic participation within the community. We experimented our proposal within a local community in the city of Turin, Italy.

CCS CONCEPTS

• **Information systems → Collaborative and social computing systems and tools**; *Incentive schemes.*

KEYWORDS

Tokenization, local economies, civic blockchain, Internet of values 2.0.

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1 INTRODUCTION

The term "Internet of Values" describes a space where monetary value exchanges can take place between two users without any middleman. Since the advent of the first fully decentralised digital currency, Bitcoin [1], in 2008, the term "Internet of Values" has become much more prominent, and the exchange of values between parties has been revolutionised. People can send money to others without relying on third parties like banks. In 2013, Ethereum was conceived by Vitalik Buterin, which brought about further developments. While the primary function of Bitcoin is value transfer between parties, thanks to Ethereum, developers could start to deploy code onto the Ethereum blockchain through its most innovative and important feature, smart contracts. A smart contract is computer code that gets compiled and executed by the nodes of a blockchain. This code cannot be updated once deployed by the developers unless specific patterns are used. The most common programming language used to develop smart contracts is Solidity, which is very similar to object-oriented languages like Java.
With Ethereum, decentralised applications (DApps) have started to be developed. DApps are decentralised because the information included in them are not saved to a centralised server owned by a company but are rather contained in a smart contract on a blockchain. An explorer such as DappRadar can be used to get an overview of current existing DApps.

The most common uses for smart contracts are decentralised finance (DeFi) and art collections (with non-fungible tokens), but they are not limited to those domains. Tokens are comparable to coins, and are often referred to as 'cryptocurrencies' [17]. Tokens can fall into two categories: 'fungible', indicating interchangeability with another identical token, or 'non-fungible', signifying uniqueness and irreplaceability. Experimentations with blockchain technology are emerging beyond finance and global cryptocurrencies. They include applications in the domains of civic participation within local or urban communities such as commoning [4], and social and solidarity economies [15, 22] . However, empirical research on actual experiments and on their social implications for local communities are still at an early stage. This paper addresses this gap by describing an experimentation that leverages blockchain as a catalyst for digital social innovation and civic engagement within local communities, which are different to the global and speculative cryptocurrencies that are most commonly associated with blockchain. Our proposal explores the potential of blockchain-based tools to orient monetary innovations towards achieving goals of public and collective interests, and encouraging citizen engagement through various tokenization mechanisms. In this paper, we describe the design and the implementation of a lending platform developed for local communities where users can put their physical items up for loan or send a borrowing request to other users. The main

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goal is to encourage the reuse of unused items and to facilitate the management of a decentralised booking system using blockchain technology.
The application is built on top of CommonsHood , a wallet app designed and developed to support social and collaborative economies in local communities [21]. It offers different tools that local communities can use to build a more inclusive and sustainable economy. They can create their own tokens, start crowdfunding initiatives, give sharing rights for tools, or represent digital collectibles like tickets to events using non-fungible tokens [2]. According to the civic blockchain approach, tokens are not limited to monetary values [21]. They hold a broader significance and can represent any asset deemed relevant by the local community.
In this paper, we present a decentralised and innovative lending system called the *Library of Things*, built as a submodule of CommonsHood . Each item on loan has a digital twin, a non-fungible token (NFT) that gets minted by the lender whenever a new item gets uploaded onto the platform. Borrowing an object has an associated cost based on the number of days requested; each day adds a number of tokens to the total cost. The crypto token we have developed for the Library of Things is called COSO (an Italian acronym meaning Organised Communities for the Exchange of Objects, and with reference to a project with the same acronym). We designed it to help and encourage community members to contribute to the system: every action which is considered good for the community generates new tokens as a reward. This helps new users to bootstrap their experience. We experimented with the Library of Things within a local community in the city of Turin, Italy. The Library of things leverages tokenization mechanisms to allow decentralized management of lending and

The structure of the paper is the following. We start with related work (Section 2), then Section 3 introduces our blockchain-based civic platform, CommonsHood (Section 3.1), while the main part is dedicated to the proposal of this paper: the Library of Things (Section 3.3), focusing on the most important aspects of its design principles. Section 4 contains the system implementation details, while Section 5 shows how our proposal was experimented and evaluated. Section 6 discusses future developments, while Section 7 ends the paper with conclusions.

2 RELATED WORK

Other authors have proposed projects on enabling digital sharing economies by sharing physical items using digital twins on blockchain. García-Moreno et al. [11] proposed a proof of concept for a decentralised rental system based on smart contracts and Ethereum. Their work is about the economic impact of sharing cars, while we are more focused on the social impact that a sharing platform of unused items can have on a small community.
Fedosov et al. [9] developed JSI (Just Share It) for sharing items using smart contract technology. While their core idea is the same as ours, the technical implementations and contexts differ in various ways. We included custom-made ERC20 and ERC721 crypto tokens that can be used across different communities in CommonsHood . Another difference is that in JSI, users can only make a new request for an item if the item is free at that moment, while in The Library of Things, users can request items for future dates.
Huckle et al. [13] explored diverse scenarios for the application of blockchain in various Internet of Things (IoT) systems, with a specific emphasis on its relevance to the sharing economy.
Ranganathan et al. [18] developed a decentralised marketplace application, which may be worth considering for any potential future development that involves not only the lending but also purchase of items. Tiansong et al. [20] applied blockchain technology to the development of an item booking platform similar to Just Share It and the Library of Things. In that system, users are only able to borrow an item when it is currently available, there is no calendar to reserve items for future dates, and standard interfaces like ERC20 or ERC721 have not been implemented.
Numerous projects leveraging blockchain technology for managing items have explored applying it to traditional libraries, and some proposals have been made by Cabello et al. [5] and Tella et al. [19]. These models utilise blockchain to monitor and manage books within a library system or physical archive. We designed the Library of Things to be flexible, envisioning its adaptability to the different needs of different communities, without limiting uploads to books. Although not our primary focus, our platform stands ready to integrate with other projects. Exploring the integration of blockchain technology in civic contexts has revealed possible applications in various scenarios with diverse potential benefits and challenges, as highlighted in [21]. This pivotal insight has motivated our conceptualisation of the Library of Things, where the forefront of technology converges with civic applications.

3 AN OBJECT LENDING SYSTEM FOR LOCAL COMMUNITIES

In this Section we first introduce CommonsHood , our platform for civic blockchain, then we introduce the Library of Things,. Indeed, the Library of Things is meant as one of the different functionalities that CommonsHood will offer, thus providing users with a modular set of tokenized assets and exchange functionalities. Specifically, with the Library of Things we explore the potentials of NFTs and of fungible tokens for enabling disintermediated tracking and management of lending, and for setting up a basic scheme of incentives hat reward collaborative actions.

3.1 The CommonsHood wallet app

CommonsHood [2, 21] is a blockchain-based wallet app with the main goal of providing users with tools to customise tokens representing material and immaterial assets that can be exchanged in local community economies. Its core function is to enable the fluid circulation and redistribution of such assets by representing them as tokens, and ensuring secure and direct transactions without intermediaries. Users can create their own ERC20 tokens to use in their own community, or create NFTs that act as coupons or tickets for events. Thanks to the web interface, users can view local economy initiatives, they can participate in these initiatives using instant payments and QR code deep-links, or they can propose new initiatives of their own. CommonsHood focuses on local communities, and has social and informational, and not only economic, aspects. It is integrated with the FirstLife local civic social network, and is a working application that can be used for real-world experiments. You can find the web app by following this link:

https://dapp.commonshood.eu.
CommonsHood introduces a range of local financial tools such as coins, coupons, token exchanges, NFTs and crowdsales [2]. In our case study, we focus specifically on **coins** and **NFTs**. The app supports and enables different kinds of social and collaborative economies in local communities such as: reward schemes for civic actions, loyalty schemes for local economic activities, urban commons, complementary welfare systems, and local sharing economies. Unlike other proposals in the field of Blockchain for Social Good, CommonsHood does not propose local community organisation based on a single type of token or single complementary currency. Citizens and stakeholders have the ability to create their own tokens to regulate their initiatives in their local area. This allows the creation of sub-communities within the area offering initiatives where participation is contingent on the possession of a particular coin or coupon. A citizen might want to acquire a particular coin through volunteering activities, but then might want to participate in a crowdfunding that requires a different type of coin as input. To support such scenarios, CommonsHood offers the possibility of token exchange (the sale of coins or coupons). The object of the case study presented in this paper is local sharing economies.

3.2 Local sharing economies and blockchain

Before going further into our case study, we shall clarify our conception of local sharing (or collaborative) economies. With this term, we refer to digitally-enabled community-oriented sharing systems that take place at the local level and which are different to business-oriented sharing economies that rely on global commercial platforms ([7, 14, 16]). In what follows, we explore the potential benefits of integrating blockchain technology with such digital sharing platforms. Building upon the work of Bogner et al. [3], who demonstrated the feasibility of a sharing app built on Ethereum, our objective is to extend their approach by presenting a local sharing economy model centred around underutilised items. We achieve this by implementing a tokenization system into our platform. By tokenization, we mean the process of integrating cryptographic tokens to represent either physical goods or currencies. These tokens are community specific, so one community can choose to create its own type of token and provide a set of rules that apply to them.
Tokenization models serve as valuable tools for enabling mechanisms that are relevant for implementing sharing economies within local communities. Tokenization models can:

- **represent physical objects and assets digitally**, thus making them more liquid and fostering their circulation;
- **integrate gamification schemes**, thus stimulating citizen engagement. Jian Wang et al. [23] emphasise that integrating NFTs and cryptocurrencies significantly enhances gamification within a platform;
- **reward positive actions**: acknowledging positive actions accomplished by community members, and fostering collaboration to make the process trustworthy;

3.3 The Library of Things

The application described in this paper is called the Library of Things. The name refers to its main goal: enabling users to manage their own library of items or "things" and let other users borrow these items without the need for an intermediary "bookkeeper". The Library of Things was developed as a submodule of CommonsHood.

The main user flow is as follows:

(1) **Registration and Initial Token Allocation**: When a person joins the platform and agrees to the rules, they receive some welcome tokens. These welcome tokens can be used to start making booking requests.
(2) **Item Upload and Digital Twin Creation**: The first time a user uploads an item, a digital twin of the item is minted in a personal collection created specifically for the Library of Things. This collection is updated with new digital twins for each subsequent item uploaded by the user.
(3) **Borrowing Request**: A borrower sends a booking request for an item, selecting the period of interest from a calendar. It takes one token for borrowing an item per day. The loan status is marked as "pending".
(4) **Request Handling**: The request is sent to the lender who decides whether accepting it or refusing it. If accepted, the loan state changes to "accepted".
(5) **Initiation of Lending Phase**: The lender meets the borrower to hand over the article. When the borrower confirm the delivery, the loan state changes to "started".
(6) **Usage Phase**: During this time, the item is used by the borrower for the agreed period.
(7) **Return of Item**: The borrower returns back the article to the respective owner. The NFT returns int the lender's wallet.
(8) **Completion and Feedback**: The owner confirms the article conditions leaving comments if necessary noting whether it has been returned damage or not. Both participants confirm the positive conclusion of the loan, which status is now marked as "ended".

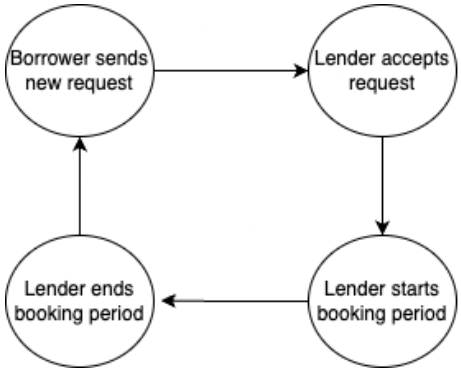

Figure 1: The full cycle of a loan

Figure 1 shows the full cycle of a loan, starting from the borrower's request. The following paragraphs provide more information on specific aspects.

The crypto token we have developed for the Library of Things is called COSO (an Italian acronym meaning Organised Communities for the Exchange of Objects, and with reference to a project with the same acronym). The price of each loan is calculated as follows: one token for every day the item is requested plus a deposit (both

values can be decided by the owner of the object). For our first experimentation, we set the deposit to zero following to requirements form the users community. When a user makes a new request, the tokens requested for the loan are sent to the main Library of Things smart contract. The tokens are sent to the owner of the item at the end of the lending period, at which point the owner can state whether or not the item was broken. and the deposit tokens are transferred to the borrower or lender accordingly. We know that this solution gives more power to the lender than the borrower, but we need to keep in mind that we're dealing with small communities, so there is no need to be too strict, and possible disputes can be resolved in person.

The user experience was designed such that technical knowledge about blockchain or cryptocurrencies is not required.

We want to reward users for every action that contributes to personal relationships and collaboration within the local community. Each reward involves the minting of an amount of tokens inside the wallet of the user. We have planned the following rewards:

- **membership reward**: ten tokens are minted when community rules are accepted for the first time;
- **community reward**: two tokens are minted when a user uploads an item onto the platform;
- **trust reward**: one token is minted when the loan period is finished;
- **care reward**: two tokens are minted when a borrowed item is handed back in good condition to its owner;

Lending physical goods represents an important opportunity for small communities. It offers multiple benefits such as promoting the environmentally and economically sustainable practice of recycling old and unused items, and providing the borrower with cost savings when compared to purchasing new items from a shop. We also strive to improve social sustainability by strengthening social bonds. In order to achieve these diverse goals, the Library of Things prioritises the following key aspects:

- **loan management**: we want the members of a community to be able to manage their lending and borrowing easily;
- **digital twin**: the concept of digital twin has been widely explored in literature [12]. Aware of the fact that it is often referred to more complex digital objects, here we use the concept of digital twin as digital representation of a physical item. In our case, each item is uniquely represented by a non-fungible token (NFT) owned by the lender: the digital counterpart ensures effective tracking. This makes it possible to digitally track and transfer possession of physical goods;
- **reward for positive actions**: community members receive rewards for accomplishing positive actions, which fosters collaboration and makes the process more trustworthy;
- **the importance of physicality**: we recognise the potential for depersonalisation caused by digital solutions in small communities; our goal is to use digital platforms to enhance, rather than diminish, personal encounters among community members in urban spaces: both parties must meet in person at the beginning and end of the lending period.

4 SYSTEM IMPLEMENTATION

In this section, we go deeper into the architecture of our system. We start with an overview of the overall architecture and then we focus on each subsystem, providing a detailed explanation of their roles and how they are connected to the rest of the system.

4.1 Architecture overview

We start with a bottom-up view of the architecture. The Library of Things uses a consortium blockchain that the research team has used in all blockchain-based projects. The nodes of the network are maintained by the local stakeholders. Since the platform is based on the Ethereum[1] blockchain technology, we have developed five smart contracts in Solidity: `Calendar`, `ItemMarketplace`, `HashRegistry`, `TokenTemplate`, and `NftTemplate`. `ItemMarketplace` stores Library of Things items, `Calendar` contains booking requests, `HashRegistry` contains the hashes used for each request, `TokenTemplate` is an implementation of the ERC20 standard that we used for the tokens, and `NftTemplate` stores the NFT of each item and is an implementation of the ERC721 standard, its metadata is saved in a IPFS node. It's hard for the client to efficiently handle complicated queries that involve reading events from smart contracts. Therefore, we have opted for a more scalable solution that implements a NodeJS microservice. Its main goal is to listen out for events emitted from the smart contracts and save them inside a MongoDB database. All the clients query this database through an API built using another NodeJS microservice that uses Express. This kind of middleware between the clients and the database is called "metadata-dapp". The process of saving events inside a database is an established practice in the industry. OpenSea has also adopted this model [8], and their APIs and clients query a database with all the information they need.

4.2 Smart Contracts

Now we shall delve into the most important smart contracts. We will first look at `ItemMarketplace`. This smart contract is responsible for saving information about the items that are currently present in the Library of Things. The smart contract has a set of functions that make it possible to:

- upload new items;
- transfer an NFT between users;
- add or remove categories (to group together similar items). Each item is grouped in a category;
- issue a reward when a user joins the app for the first time;
- remove items;

`ItemMarketplace` also receives tokens when a new booking request is sent by a user. To save and access the information of an item, we use a mapping, with a counter as key.

Once an item is registered, the digital twin is transferred from the user to the ItemMarketplace smart contract, and each time a loan begins, the item NFT is transferred from the smart contract to the user who has requested the item. Then, at the end of the lending period, it is transferred back to the smart contract.

[1] https://ethereum.org

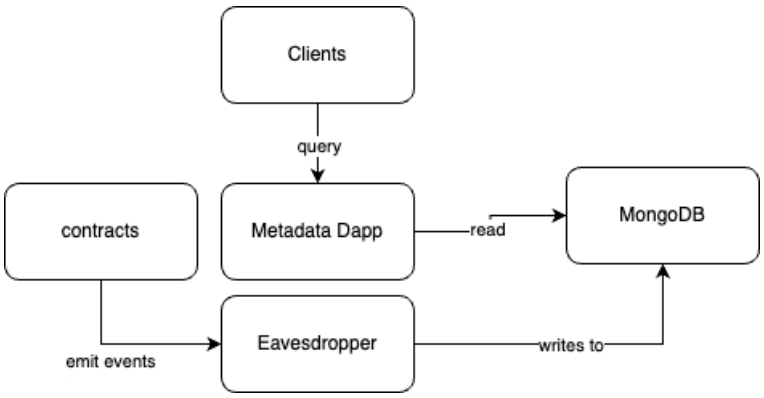

Figure 2: System architecture

The second most important smart contract is `Calendar`. It is responsibile for handling booking requests. This smart contract has a set of functions that manipulate the state of each loan, specifically:

- created
- cancelled
- accepted
- ended

The last smart contract discussed in this section is `HashRegistry`. It is responsible for saving and checking the hashes used when a new booking request is sent to the `Calendar` contract. Only the `Calendar` smart contract can register a new hash in `HashRegistry`.

4.3 The booking system

In this section, we focus on the core feature of the application: how we made the booking system work. For each item, there must be a calendar that shows the user which days the item is available and unavailable. This is not an easy task because saving and maintaining a whole calendar in a smart contract is expensive. We solved this problem with the following steps:

- the client queries the metadata-dapp microservice to find out if an item is available in a specific time period (Figure 2)
- each time an item is requested, the start and end dates are emitted using an event from the `Calendar` smart contract (Figure 2)
- the Eavesdropper microservice saves these dates in the MongoDB database (Figure 2)

Following these steps is not enough because it doesn't address the problem of multiple requests for a specific item for the same period. As such, we have included an extra check to make sure that only valid requests can be saved to the `Calendar` smart contract. Each time a booking request is made, metadata-dapp checks if the dates requested by the client are available in the MongoDB database. If they are available, a message is signed using the private key of a specific Externally Owned Account (EOA) called the "notary". When a client calls on the smart contract to add a booking request, it must also send a signed message as a parameter. The `HashRegistry` checks if the message was signed by the notary, and if so, the request is deemed valid and those dates are available. We use the Elliptic Curve Digital Signature Algorithm (ECDSA) to check if the message has been signed by the notary (Listing 1).

Listing 1: Register signature

```
function registerSignature(
    bytes32 _hashToCheck,
    bytes memory _signature
) public onlyWhitelistedAddress {
    require(
        !hashRegistry[_hashToCheck],
        "Hash already used"
    );
    require(
        ECDSA.recover(_hashToCheck, _signature)
        == notary,
        "Signer does not match the notary"
    );
    hashRegistry[_hashToCheck] = true;
}
```

This function is the core of our booking system because it allows us to filter out requests that clash with other dates. We could have placed this function inside the `Calendar` smart contract, but we decided not to. This is because we wanted to have a single source of truth for the hashes used by the users.

4.4 The Library of Things Web App

Before going deeper on the features of the Web App we want to make a brief overview on the technologies we have used to develop our client. We focused our efforts on making the experience unique for the user, to achieve this goal we have used state of the art technology such as ReactJS, Typescript, MongoDB and a REST API built completely from scratch that allows us to query information on our smart contracts effortlessly, faster than ever. We designed the client to be as user-friendly as possible, even for those who have no experience or knowledge of blockchain.

Each user can upload an item to the Library of Things through an online form (Figure 3(a)). The only information required are name, image, item category and the deposit amount. The first time

a user creates an item, the app checks whether (s)he already owns an NFT collection in which to store the new item. If not, a new one is created and then the NFT is minted into the collection. Note that for our experimentation, we have set the deposit amount to zero for every user. The user can request an item from the homepage (Figure 3(b)) by selecting the requested dates from the item calendar (Figure 3(c)). We also decided to set the daily cost of each item to 1 token, but in future versions this can easily be changed. Once the item gets minted, it can be accessed from the user's profile where all his/her items are stored. The list of lended and borrowed objects is available in two dedicated sections of the application (Figure 3(d) (e)) The full list of items that are available can be seen in the home page, and filtered by categories. The status of the requests and loans is tracked in two separate sections where the users see the objects they are lending and the objects they are borrowing respectively.

After an item request is sent to the lender, the lending request must be approved by the item owner. The two actors will then meet in person and the lending period will officially start. When the borrower receives the requested item, his wallet will also receive the related NFT. At the end of this period the two actors will meet once again, the item is given back to the owner, both will receive a reward in ERC20 tokens directly in their wallets, the NFT is transferred back to the owner and he can also review the state of the item.

When an item is requested, it's owner has also the possibility to reject the request. In this case the borrower will immediately receive back the ERC20 tokens he froze to send this request and no NFT will be transferred. One of the most frequest feedbacks we have received from the tests is that the users were missing a way to communicate inside the app. Since the implementation of a web chat would be very costly in terms of effort, we still have decided to accommodate this request. For this reason we have included automatic emails that will be triggered whenever an item request is received or when a lending period ends.

4.5 Security and evaluation of smart contracts

To better check the security of our smart contracts, we used Slither [10], a static analysis tool that when run on the code of a smart contract can show if it is vulnerable to a re-entrancy attack [6] or other common attacks like timestamp dependence, insecure arithmetic or denial of service. The result of the Slither analysis revealed no critical bugs. The only issues identified were related to the naming conventions used for certain variables.

5 SYSTEM CO-DESIGN, TESTING AND EVALUATION

The Library of Things was initially designed to meet the requirements of COSO , a project implemented in a neighborhood of the city Turin (Italy) with the goal of strengthening community relationships and making it easier to borrow and lend unused items within a community. COSO (an Italian acronym meaning Organised Communities for the Exchange of Objects) participants took part in various phases of app development, from co-design to testing and evaluation.

A group of 12 people took part to four co-design sessions in the period March-June 2023, focusing on issues from the design of the core token model to the design of the user interface. This allowed us to define the priorities, the rewards and the loans states described above in Section 3.3. A restricted group of four experts among the community members took part in the testing phase of the alpha version of the Library of Things in the period October 2023-January 2024. The three testing sessions followed a structured approach. The testers were assigned specific tasks to be completed autonomously, and were asked to provide their comments on the user experience. The developers recorded the reported problems and suggestions for improvement, which led to immediate adjustments. Namely, the cost of items was standardized to 1 token. This adjustment was crucial to prevent disparity, since users with more tokens tended to borrow higher-value items, which diverges from COSO 's fundamental ethos of creating a platform that is accessible and affordable to everyone. As the application attained the milestone of minimum viable product (MVP), essential feedback emerged concerning communication within the platform. Testers articulated a need for intra-platform communication and messaging system, while allowing more traditional methods by providing personal phone numbers or emails. The broader COSO community took part in an open testing session in March 2024, in which 20 people tried the whole process from registration to loan request, start and termination. Developers and community leaders observed the spontaneous reaction of the testers (questions, difficulties, positive comments), and asked them specific feedbacks on the general usability and on the perceived relevance and utility of the application. Additional comments were provided in the following weeks by the COSO community experts, who keep using the application in real life settings , thus reinforcing the initial feedbacks. Moreover, further comments came from other co-design and testing processeses in the period March-May 2024. The "CommonsHood in the Garden" pilot is another experience of social collaborative economy in Turin, around a collective urban garden where the Library of Thing is focused on gardening tools. The Futurama projects involves four high school classes in the cities of Agrigento and Trapani (Italy) in adapting the COSO models to their school context, co-designing and testing their own version of the application. These iterative tests converged in identifying the core adjustments needed to refine the platform's functionalities: communication and messaging; adding of notification for guiding the users through the flux of actions; filtering and searching for objects; management of specific cases such as simultaneous requests for the same object and delays in the objects' return. Moreover, these tests also served as a fundamental test on the platform's accessibility. Users, whether they were technically proficient or less familiar with such applications, navigated the platform seamlessly without requiring additional guidance from our UX designer.

6 FUTURE DEVELOPMENTS

Our roadmap foresees the following features. Some of them come from the initial brainstorming session and have been further enriched through iterative testing of the application.

One area that needs improvement is user communication. In our initial experimentation involving a small group of users, we facilitated communication by sharing users' email addresses once a request

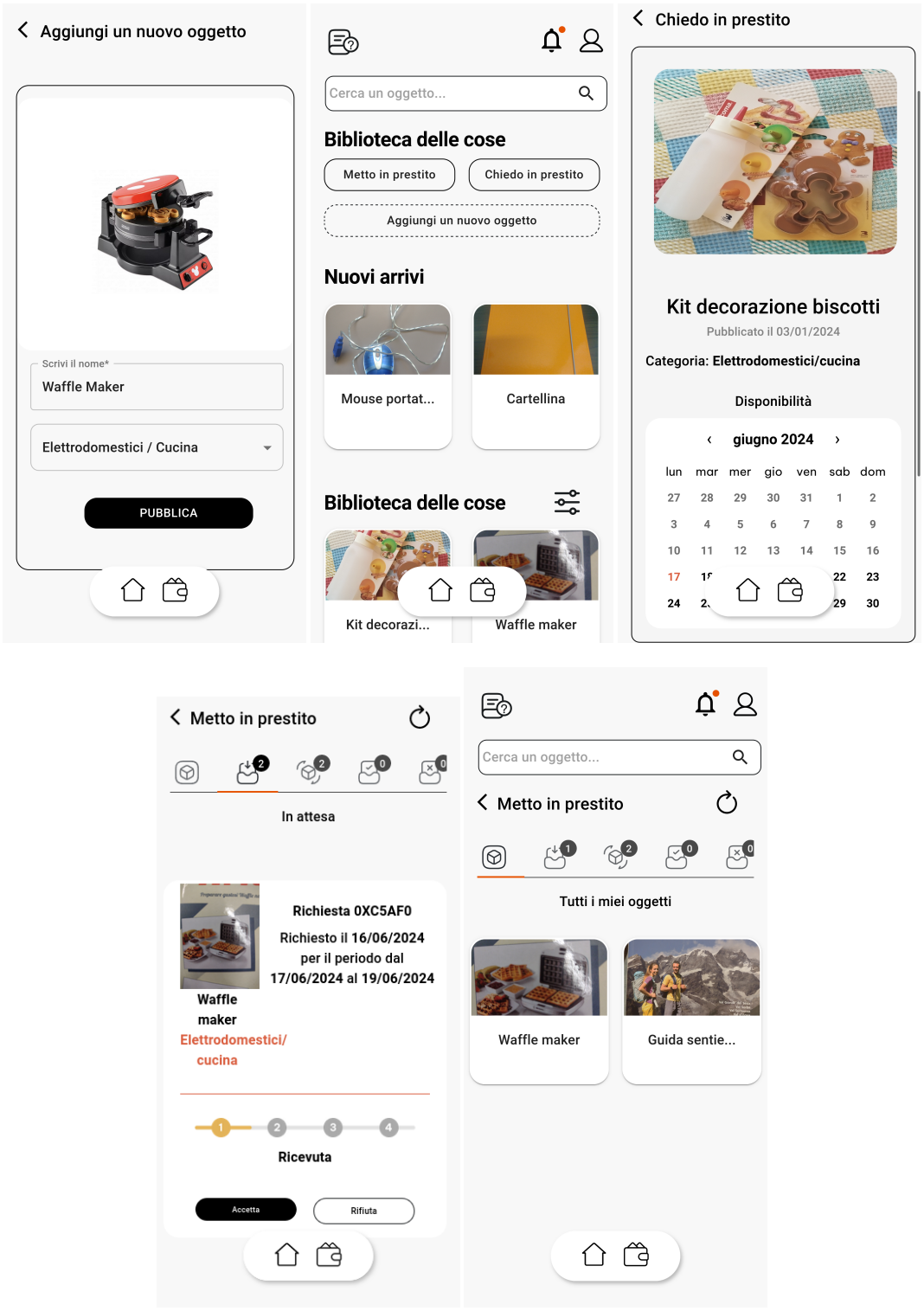

Figure 3: (a) Register new item into the Library of Things platform (b) Homepage with available objects (c) Request the loan of a selected item (d) List of requests received and (e) own items

had been accepted. However, we recognise the need for improvement. In upcoming versions, we propose to develop a straightforward messaging platform within the wallet application. This would encourage increased interaction on the website, offering users an integrated communication experience.

Another planned enhancement is an interactive map showing the geographical positions of registered communities. This feature could make it easier for other members to join or explore communities in their surrounding area.

As regards the architecture and technologies adopted, we intend to change our current back end. We will no longer use any NodeJS middleware to retrieve user information. We will include in our tech stack *The Graph*[2], a powerful tool that allows us to make complex queries using only the events emitted by the smart contracts. This will facilitate scalability and the development of new features and the development cycle as a whole.

Another goal for the near future is to include a gamification system to make the user experience more fun. All these new milestones will be subject to testing cycles and to evaluation by the users to ensure the high quality of the product we are developing. Moreover, embracing the potential of decentralised autonomous organisations (DAOs), we find intriguing developments where each community is represented by a DAO. Within this framework, community members gain agency via voting mechanisms, and can thus influence and shape platform updates. Such a democratic decision-making process would ensure dynamic and responsive evolution of the platform, fostering a sense of shared ownership and collaborative innovation.

7 CONCLUSIONS

We have developed the Library of Things, a platform that helps members of a community to find new uses for items they rarely or never use personally. Our application was initially designed in accordance with the requirements of COSO , a community-based initiative. Its core members participated in the testing phase to refine the overall user experience and find the next features to be developed for subsequent versions. We achieved our goal of developing a fully functional decentralised application that provides a simple and structured process for borrowing unused items in the community.

Each library item is represented by its digital twin, an NFT minted when a user registers an item onto the platform. After the item is uploaded, other users can send borrowing requests, selecting a start date and an end date. For each day the item is borrowed, the user pays 1 token. We have developed a custom ERC20 token called COSO The platform must be affordable for everyone; that's why each item has a standardised price of 1 token per day. Once a booking request is sent, the loan has a different status: pending, accepted, started, ended. Once the loan has ended, the NFT is transferred back to the lender. Whenever a user completes a good action in his community, (s)he is given a reward in tokens.

We have found other civic-minded projects similar to ours led by other scholars, but none of them offer the possibility of booking an item in the future like many mainstream platforms do. We use the commit-reveal strategy to handle the validation of new requests by users. This ensures that a new lending request is legitimate. We have organised multiple testing sessions in collaboration with COSO members, an initiative aimed at introducing blockchain technology to small communities to facilitate the process of reusing unused items. These sessions have been extremely useful for improving the user experience and testing whether the results obtained meet the original goals of the project. They have also highlighted the need for additional features and these will be designed and developed in subsequent releases.

Ultimately, we can confidently confirm that our research goals have been successfully achieved. Through meticulous testing sessions carried out in collaboration with members of the COSO community, we not only substantiated that there is genuine interest in our platform but also gained invaluable insights into its functionality and the user experience. The positive reception indicates that our optimism regarding the future development roadmap is well placed, and we anticipate the release of numerous enhanced versions in the next development cycles as we continue to refine and expand the capabilities of our platform.

[2]https://thegraph.com

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