EMPRESTA.ME: Distributed application for goods sharing anchored in a reputation system

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***Abstract*—This project focuses on the development of the EMPRESTA.ME platform, a proof-of-concept system designed to facilitate the sharing of underutilized physical goods among individuals and organizations. The platform aims to address the challenges of limited awareness and trustworthiness assessment in the lending process. EMPRESTA.ME leverages a distributed architecture and integrates a Reputation System with an algorithm to assess user trustworthiness through vouches. This enables effective connections between item owners and individuals in need, promoting efficient goods sharing within the platform. This report provides a comprehensive overview of the development process, including requirements gathering, system design, and implementation. By adopting a proof-of-concept approach, our project aims to showcase the feasibility of a distributed asset sharing system supported by a robust Reputation System. Additionally, our work provides valuable insights for future advancements and practical applications in real-life lending scenarios.**

***Index Terms*—asset sharing, proof-of-concept, distributed, secure, reputation score, gift economy**

I. Introduction

In today's consumer-driven society, the consumption of unnecessary goods has become a prevalent issue, leading to resource depletion and environmental degradation. However, recognizing the importance of sustainable living and responsible consumption, the necessity of a communal pool of shared goods emerges as a promising solution. Communal pools of goods are shared inventories within a community where individuals contribute and borrow items as needed, promoting resource efficiency and fostering community collaboration. This communal approach encourages people to prioritize access over ownership, fostering a culture of sharing, collaboration, and mindful consumption. By establishing a system where household items are shared within a community, the need for individual ownership of rarely used items is eliminated, reducing wasteful consumption and promoting resource efficiency and positive ecological impact.

It is common to encounter situations where individuals possess items that are not being utilized while others have a need for them but do not own them. To address this inefficiency, the optimal solution is to establish a sharing platform where these items can be mutually utilized when not in use by their owners. The need for such a platform is evident; however, currently, there is a lack of a suitable platform to facilitate the interaction and connection between interested parties in order to enable efficient item sharing.

EMPRESTA.ME exemplifies this concept by serving as an open-source, distributed, and secure platform that facilitates the formation of resource pools within and across communities. Notably, it incorporates a novel reputation system, prioritizing transparency and trustworthiness in its operations. Users are able to join communities, actively contribute to reputation assessment, and participate in item exchanges, all while considering reputation scores as a measure of credibility and trustworthiness.

II. Architecture

Such platform needs to embrace a distributed, transparent, and non-centralized architecture to foster trust, reliability, and inclusivity. This approach ensures that no single entity or central authority controls the entire system. Instead, the sharing platform operates on an interconnected network of nodes representing different communities, distributing information and transactions among participants. Decentralization mitigates the risk of a single point of failure and enhances system resilience. Moreover, transparency is crucial, as it enables users to access real-time information about shared items, availability, and transaction history. By leveraging Distributed Ledger Technologies (DLT), the application can provide an immutable and auditable record of item sharing activities, ensuring transparency and accountability.

At its essence, EMPRESTA.ME serves as a communication protocol facilitating user connections and the creation of item pools within communities. The specific implementation of this protocol is flexible and can vary. As a proof-of-concept, we have developed an Android client mobile app and a Python-based backend software solution for community management. These components are supported by a Redis database for efficient data storage and retrieval, as well as a RabbitMQ message broker for reliable communication between different system modules.

Our network follows a federated model, where communities act as communication facilitators and users have the freedom to join or leave them at will. The system is designed to be resilient against power abuse and centralization, as anyone can

start a community by running the community software. Importantly, the purpose of communities is to aid communication, not to restrict it, allowing users to interact beyond community boundaries.

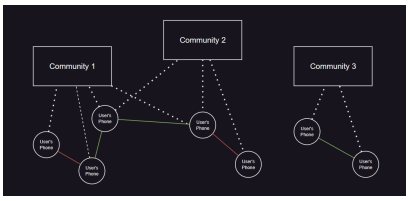

Fig. 1. A trust topology highlights the associations of nodes with different communities.

III. Reputation System

Such application should possess a robust reputation system, as it is serves as a crucial mechanism for establishing trust and ensuring responsible participation within the sharing community. The reputation system serves as a vital mechanism for providing users with insights into the reliability, trustworthiness, and past performance of other participants. By offering transparency, it enables informed decision-making during item sharing transactions. This system incentivizes responsible behavior and discourages fraudulent or irresponsible actions, fostering a culture of accountability within the community.

We have developed a unique reputation system called the Vouch Reputation System (VRS) to address these requirements. [1] VRS leverages existing social connections to derive numerical reputation scores for participants within a larger community, even those who have not directly interacted. Through vouching, users can express trust or mistrust towards others, creating a network of nodes that represents the community. By treating a node as an observer, we can estimate the reputation of other nodes based on the complex trust relationships within the network and our developed algorithm. It is essential to note that reputation scores are not universally applicable to a node but depend on the observer and the trust relationships within the network, reflecting their position in the community.

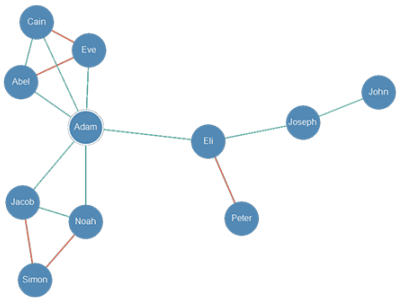

Fig. 2. A network visualized by VRS

Through the use of a robust reputation system, the application enhances reliability, credibility, and the overall success of the item sharing platform, creating a secure and trustworthy environment for all participants.

IV. Security

The importance of a robust and resilient communication protocol cannot be overstated. As the application operates in a decentralized environment, it encounters various threats and challenges. A robust protocol plays a critical role in ensuring the system's stability, security, and integrity in the face of these threats. Resilience to threats also ensures uninterrupted functionality, mitigates single points of failure, and enables the application to withstand potential disruptions.

Regarding the actual implementation of the protocol, key security measures taken include authentication and authorization mechanisms to ensure that only authorized users can access restricted functionalities. Encryption techniques are also employed to safeguard sensitive data and communications from unauthorized access. Asymmetric cryptography is thoroughly utilized throughout the protocol to ensure authenticity and non-repudiation.

Proof of Work (PoW) was incorporated as a defensive measure against Distributed Denial of Service (DDoS) attacks. By utilizing PoW, users are required to perform computational tasks in order to have their messages accepted by the network. This proactive approach strengthens the application's resistance to DDoS attacks by imposing a computational cost on malicious actors attempting to overwhelm the system with excessive requests. However, it is important to clarify that, unlike in Bitcoin where it was first popularized, Proof of Work is not utilized as a consensus mechanism for transaction validation or achieving consensus within the network, but rather solely as a security measure. Consensus within the system is established through the utilization of gossip communication and digital signatures.

V. Conclusion

Despite undergoing numerous modifications throughout the project, we successfully developed a proof-of-concept that aligns with the initial essential requirements. However, it is crucial to note that the system necessitates additional deliberation and is not currently ready for release as a marketable product. Nonetheless, the proof-of-concept offers valuable insights into the potential and benefits of incorporating compact and secure distributed systems within communal environments. As we move towards a more collaborative and resource-efficient future, this application paves the way for the establishment of a thriving sharing economy.

References

[1] Reputation System Documentation — EMPRESTA.ME. Available at: https://empresta-me.netlify.app/docs/1.0/Reputation$_{System}$